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Don't take "geography" for granted!
Some methodological issues in measuring geographic distribution of physicians

Raymond W. Pong, PhD
J. Roger Pitblado, PhD

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• Abstract • Introduction • The nature of the problem
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Geographic maldistribution of physicians is a major health services delivery issue in Canada. Most discussions of geographic distribution of physicians are based on population-to-physician ratios because such ratios are easy to construct and understand. However, simple head counts of physicians and people within an area often obscure the underlying complexity of the situation. This paper discusses some of these inadequacies through an extensive review of the literature. The objective was to examine the problems inherent in using an arbitrarily defined geographic area, problems such as the mobility of physicians and patients and the lack of consensus on what "rural" means. Various methods for overcoming these difficulties are discussed

La mauvaise répartition géographique des médecins constitue un problème majeur pour la prestation des services de santé au Canada. La plupart des discussions sur la répartition géographique des médecins sont fondées sur des ratios médecin:habitants parce que ces ratios sont faciles à établir et à comprendre. Un simple dénombrement des médecins et de la population d'une région fait toutefois oublier souvent la complexité qui sous-tend la situation. Cette communication décrit certaines de ces lacunes au moyen d'une recension détaillée des écrits. L'étude visait à examiner les problèmes inhérents à l'utilisation d'une région géographique arbitraire, soit, notamment, la mobilité des médecins et des patients et l'absence de consensus sur la signification du mot «rural». On discute de diverses façons de surmonter ces difficultés.

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Geographic maldistribution of physicians is a major health care issue in Canada. Most discussions on this topic are based on population-to-physician ratios because they are easy to understand and construct. However, the ratio's simplicity sometimes obscures the complexity of the problem. This paper outlines some of the problems and inadequacies of the system.

This paper is the first of two1 articles that seek to lay the conceptual foundation for understanding physician distribution. It is based on a study2 that examines the geographic distribution of physicians in Canada. Our analysis has shown that the spatial distribution of physicians is a much more complex issue than it appears and that the problems associated with the geographical aspect of physician distribution are commonly overlooked. The commonly used measures of physician availability in a specific area, such as the population-to-physician ratio, can be unsatisfactory at best and misleading at worst, if researchers do not pay due attention to the geographical aspect.

This article is based on an extensive review and a critical assessment of the literature, including research studies, health service planning reports and Internet documents. We examine how the geographic distribution of physicians has been measured by researchers, identify the problems they have encountered and assess the attempts to overcome these problems. An extensive literature search and review process was conducted.2

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The nature of the problem

Geographic distribution of physicians is just a short way of describing what is of interest to most people. Information solely about where physicians are located is of limited use. Instead, people are mostly interested in the spatial distribution of physicians relative to the spatial distribution of the population. This is why the population-to-physician ratio is the most commonly used measure in research and health service planning. It is a ratio that relates information on physician distribution to information on population distribution. Besides being fairly easy to construct and understand, it is the basis on which more elaborate indices of spatial distribution, such as location quotient and Gini index, are built.3

The population-to-physician ratio is used by many researchers and health service planners because of its simplicity and minimal data requirements. A survey conducted by the National Ad Hoc Working Group on Physician Resource Planning4 of the Canadian Medical Association found that 9 of the 10 provinces employed this ratio in their planning activities. Health services planners in Canada have used population-to-physician ratios extensively in medical workforce

planning, beginning with the 1964 Royal Commission on Health Services.5 However, pictures presented by population- to-physician ratios may be oversimplified or even misleading. The first step in advancing this area of research, as well as in supporting policy formulation and program planning, is to enhance our ability to describe the spatial distribution of physicians more precisely.

A typical population-to-physician ratio contains 3 pieces of information, both implicit and explicit: the geographic area within which the physicians and people are located, the number of physicians and the number of people. The number of people residing in an area need not necessarily be the total population. For instance, if the denominator is the number of geriatricians, the numerator could be the number of people aged 65 years and over in the area. Similarly, if the denominator is the number of obstetricians/gynecologists, the numerator could be the number of women in the area. Refinements of this deceptively simple ratio are attempts to conceptually clarify these 3 variables and to measure them more accurately. As noted earlier, this paper deals with only 1 of the 3 variables, namely, geographic area. The other 2 variables will be discussed in greater detail in a future issue of this Journal.

The "geographic area" that is implicit in any population-to-physician ratio presents 2 major problems. First, the geographic areas tend to be artificial and do not necessarily reflect the natural geographic patterns of health care delivery and consumption. This has a lot to do with data availability. As Taylor and colleagues6 have pointed out, "finding data at the level of aggregation desired for identification of the underserved area is often very difficult...decisions regarding the definition of a concept or term that is key in research are often driven by the availability of data."6 It explains the attractiveness of using province, county, health region or census division (CD) as the geographic unit of analysis since most population, manpower and health data are reported at the province, county, health region or CD level. Second, and somewhat related to the first point, is the assumption that all health care consumption and delivery activities take place within the defined geographic area. Such an assumption is often untenable.

1. Geographic units used

As Northcott7 has observed, one of the major issues in discussing equity in the distribution of health services or practitioners rests with the unit of analysis. Geographic unit of analysis refers to what geographic area is to be adopted in determining the numbers of people and physicians to be included in the population-to-physician ratio. Various units have been used by researchers. For instance, at the sub-provincial level, both Anderson and Rosenberg8 and Coyte and coworkers9 used counties as the unit of analysis in their examinations of the distribution of physicians in Ontario. Pitblado and Pong10 on the other hand, examined variations among public health unit districts in access to physicians and dentists in Ontario. Northcott7 employed 2 geographic units of analysis in his study of physician availability in Alberta: CDs and incorporated cities, towns and villages. Contandriopoulos and Fournier11 used health planning regions to examine access to medical services in Quebec. It is also very common to compare rural with urban areas. Because of the importance of this unit of analysis, "rural" is discussed separately and in greater detail

below. At the sub-national level, health planning reports and health workforce data documents typically use province and territory as the unit for comparison.12,13

At the international level, Deliège14 and Mejia15 compared countries with respect to population-to-physician ratios. Ray,16 on the other hand, compared groups of countries at different levels of economic development with respect to the numbers of physicians and nurses per 100 000 population.

The major problem of using geopolitical or administrative areas, such as counties, or statistical enumeration areas, such as CDs, is that they are artificial and not necessarily the most appropriate units of analysis. Some units, like provinces, are simply too large and tend to hide regional variations. For example, in 19962 the overall Canadian population- to-physician ratio was 1022 for general practitioners/family physicians (GPs/FPs). Computed by province/territory, this ratio ranged from 769 in Yukon to 1359 in Prince Edward Island. The figure of 1022 for Canada clearly masks the provincial/territorial differences. Similarly, the provincial/territorial figures mask the population-to-GP/FP ratios when the ratios are computed using CDs as the unit of analysis. Whereas the range of the provincial/territorial population-to-GP/FP ratios is from 769 to 1359, the ratios computed at the CD level range from 392 to 8901! If a smaller unit of analysis (e.g., census subdivision) were used, the range would be even greater.

Other geopolitical or administrative areas may not reflect the planning, distribution or organization of health services. Even "health regions" may not be an appropriate unit of analysis. Take Ontario as an example. Although regional health services are supposedly planned and coordinated by the district health councils (DHCs), the recent DHC amalgamation exercise, driven mostly by government downsizing and budgetary constraints, has resulted in some mammoth planning regions discernible in such names as the "Durham, Haliburton, Kawartha and Pine Ridge District Health Council" or the "Algoma, Cochrane, Manitoulin and Sudbury District Health Council." Analysis of medical service provision or consumption, using DHCs as the unit of analysis, would not be very revealing. Similarly, Plain17 has pointed out that in Alberta, the "administrative boundaries that have been drawn up for RHAs (regional health authorities) are not based on health care catchment boundaries or health market service market criteria." For these reasons, both Jacoby18 and Kindig and Ricketts19 have urged the adoption of units of analysis that are more appropriate for the study of physician services, such as "physician market area" or "health service trade area."

Researchers have experimented with other geographic units of analysis. Makuc and colleagues20 have attempted to define national "health service areas" in the US. A health service area is an area with one or more counties that are relatively self-contained with respect to the provision of routine hospital care. Using cluster analysis, the authors were able to group all counties into 802 health service areas. These areas are more self-contained with respect to the provision of hospital services, thereby providing a more appropriate geographic unit than the county for measuring the availability of health care. Makuc and colleagues found that the median number of patient-care

physicians per 100 000 population was 84 for non-metropolitan health service areas and 132 for metropolitan health service areas.

Krasner and coworkers21 have advocated the use of "zipcode sectional areas" as a geographic unit for analyzing the distribution of physicians in the US. These areas are identified by the first 3 digits of the 5-digit zipcode number. Because zipcode areas are established on the basis of local transportation patterns, they tend to approximate trading areas. Krasner and coworkers have examined the distribution of dermatologists in the US based on this unit of analysis. Using a similar rationale, Morrow22 has promoted the use of Office of Business Economic (OBE) areas as the unit of analysis. OBE area designations are based on factors describing commuting patterns exhibited by people travelling to receive or sell their services and products in the US. According to Morrow, OBE areas are better approximations of health care market areas. In Canada, Roos and colleagues23 have used "physician service areas" to study the needs for generalist physicians in Manitoba.

2. "Rural" as a geographic unit of analysis

One of the most commonly used geographic units of analysis in physician-distribution studies is "rural." In such studies, the unit of analysis is rural versus urban or rural versus nonrural. Instead of comparing physician availability in many units, researchers typically present physician distribution data for rural and urban regions with a view to emphasizing the disparities. In addition, some researchers have introduced the concepts of "frontier" and "remote" to distinguish the sparsely populated rural areas from those that have more inhabitants.24,25 The Rural Committee of the Canadian Association of Emergency Physicians defines "rural remote" as rural communities that are 80–400 km, or about 1 to 4 hours' travel in good weather, from a major regional hospital; and "rural isolated" as rural communities that are more than 400 km from a major regional hospital.23 In the US, the National Rural Health Association defines frontier counties as counties with less than 6 persons per square mile.24

However, there are almost as many definitions of "rural" as there are researchers. To make a bad situation worse, it is not uncommon for authors to use the term without specifying what it means. Bosak and Perlman26 reviewed 178 rural mental health and sociology articles and found that 43% of them did not include a formal definition of rural. More recently, Ricketts and Johnson-Webb27 have reviewed articles on physician practice locations and physician recruitment and retention issues published in the Journal of Rural Health between 1993 and 1995 and have found wide variations in how rural was defined. Furthermore, the concepts of rural and urban are not constant. Bollman and Biggs,28 for instance, have documented the changing definitions of rural and urban as used by the Canadian Censuses of Population.

In its report, the Canadian Medical Association Advisory Panel on the Provision of Medical Services in Underserviced Regions29 defined rural communities as those with a population of 10 000 or less. This definition appears to be similar to the definition of "rural and small town Canada" used by Mendelson and Bollman.30 "Rural and small town Canada" refers to the

population living outside the commuting zones of larger urban centres -- especially outside census metropolitan areas (CMAs) (i.e., areas with a population of 100 000 or more) and census agglomerations (CAs) (i.e., areas with a core population of 10 000–99 999). Statistics Canada31 classifies areas into 5 categories: urban core (CMAs/CAs), urban fringe, rural fringe of CMAs/CAs, urban outside CMAs/CAs and rural. While agreeing that the Statistics Canada definition of rural is useful, the National Liberal Rural Caucus,32 in its report titled "National Rural Health Strategy," maintained that communities with more than 10 000 people should be considered rural if their economic foundation is based on primary production and processing activities, rural culture or nature tourism.

In their study, Sanmartin and Snidal33 defined Canadian rural physicians as those living in areas with a "0" (zero) as the second character (first number) in the postal code (e.g., K0A 2Y0). An agreement between the Ontario Ministry of Health and the Ontario Medical Association defines communities that have fewer than 10 000 people and are at least 80 km from an urban centre with 50 000 population or more as "specified" or "isolated" communities.24 This is often used as a definition of rural in health service planning in Ontario.

Each of these definitions has its attractiveness and limitations. As an illustration, Wilkins34 has discussed the potential of using the postal codes of patients and health care providers in the spatial analysis of health care provision. On the other hand, the shortcomings of the Canada Post definition of rural (i.e., areas with a "0" (zero) as the second character in the postal code) have been noted by Wootton.4 Furthermore, although Wilkins' approach may have been useful in the past, it is becoming less so. Indeed, Canada Post has indicated that in the future this method of distinguishing between rural and urban areas will be extremely unreliable (Heather Kinsley, Manager, Address Management Data and Systems, Canada Post: personal communication, 1997).

Some of the major Canadian definitions of rural are summarized in Table 1.24,31,33–40

To overcome the problems of using the conventional definitions of rural, Weinert and Boik25 have designed the Montana State University Rural Index. This index assigns a value (degree of rurality) to each household on the urban/rural continuum using only 2 variables: population of the county of residence and distance to emergency care. In addition, Fickenscher and Lagerwey-Voorman41 have differentiated 4 types of rural areas: adjacent rural areas, urbanized rural areas, countryside rural areas and frontier areas.

Leduc39 is right when he opines that "[a] widely accepted and validated definition of 'rural' in the context of medical practice has not yet been developed in Canada." Perhaps, as Halfacree42 has suggested, the search for a single, all-purpose definition of rural is neither desirable nor feasible. How "rural" should be defined depends on the task at hand. Thus, rural as a geographic unit of analysis is quite restricted in its utility. As it appears in most studies, the concept is either implicit or not consistently defined. Also, because rural covers a vast territory (about 90% of the land

mass in Canada can be considered rural) and is not sufficiently differentiated to reflect varying degrees of rurality, it tends to mask intraregional variations in physician availability and population dispersion. However, a rural–urban comparison can be effective in highlighting the gross unevenness in physician availability. Its imprecision notwithstanding, the term "rural" is unlikely to disappear from everyday parlance or health service planning discourse because it is such a convenient label and is so ingrained in our consciousness.

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Complicating factors in choice of units

1. Patient and physician mobility

The choice of geographic units of analysis is further complicated by a related factor -- patient and physician mobility.20–22,43,44 As peripatetic creatures, patients and physicians are not necessarily constrained by administrative or geopolitical boundaries in seeking or delivering care. Trips to another community to seek or deliver care are common. Kleinman and Makuc45 found that the percentage of physician visits that involved county-border crossing in the US varied from 7% for people in greater metropolitan core counties to 45% for those residing in rural counties. Similarly, Contandriopoulos and Fournier11 have documented the substantial interregional mobility of physicians and patients in Quebec. In their study of physician visits by older persons in a retirement community in northern Ontario, Pong, Salmoni and Heard46 found that, whereas more than 95% of the visits to GPs/FPs occurred within the community, over two-thirds of the specialist visits took place in other cities, which required patients to travel long distances.

What are the implications of border crossing? As mentioned earlier, the conventional population-to- physician ratio is based on the assumption that provision and consumption of medical care take place within a defined geographic area. This assumption is often untenable due to patient and physician mobility. The simple population-to-physician ratio may provide inaccurate information because the physicians represented in the denominator of the equation for a particular geographic area typically serve more people than those counted in the numerator. On the other hand, the people counted in the numerator may receive care from physicians outside the area where they reside.

Researchers inevitably find themselves caught in a Catch-22 situation when deciding what geographic unit of analysis to adopt. If the chosen unit of analysis is small, the measures of physician availability are likely to be distorted by patients' and/or physicians' cross-border travels. On the other hand, if the unit of analysis is very large, such as country, province or "rural," while people are less likely to journey beyond borders, the measures of physician distribution tend to hide intraregional differences.8,47 Because of this analytical dilemma,

Connor and colleagues,48 in their overview of the literature in this area, have differentiated 2 types of analysis. One type is called the "contained-area model"; this is based on the traditional concept of a self-contained local service area with well-defined boundaries, within which a local practitioner or a group of practitioners provides most of the care for local residents. The other is the "full-travel model"; it measures the effects of travel on physician access as a continuous function of distance or time. It allows each of several practitioners to have a portion of the market for a given population.

A number of analytical approaches have been suggested, with a view to overcoming the difficulties posed by geographic unit of analysis and/or travel by patients and physicians. For example, the Quebec Ministry of Health and Social Services49 has proposed a physician resources distribution plan that estimates physician availability based on full-time equivalents (FTEs). The objective of the plan is to measure regional disparities in terms of availability and access to medical care. Data can be examined in several ways.

Number of FTE physicians established in a region: This refers to the actual production of services by physicians within a region, regardless of the origin of the patients receiving these services or the region in which they are provided.

Number of FTE physicians available in a region: This refers not to the region where the physicians are established but to the region in which services are provided.

Consumption in FTE physicians by the population of a region: This allows the examination of the volume of medical services consumed by the population of a region, translated into FTE physicians, regardless of the regions in which the services are consumed or the origins of the physicians providing them.

The difference between the number of FTEs established and the number of FTEs available provides an indication of the extent of itinerancy. On the other hand, the difference between the number of FTEs established or available in a region and the population's consumption, in terms of FTEs, provides an indication of the region's self-sufficiency in the provision of medical care.

Wing and Reynolds44 have suggested another approach, which does not rely on non-overlapping geopolitical units. They have developed implicit physician service areas that are probabilistic and interpenetrating in order to yield estimates of the supply of physician services in small geographic areas. This is accomplished by allocating a portion of the services of each physician to his or her home area and to other areas in proportion to both the availability of potential patients and the propensity of patients to travel for medical care. The final estimate of the availability of physician services in each small area is the sum of the service proportions of every physician in all of the small areas. The total supply of physician services is the same as the original total, but the distribution is adjusted to reflect the time that patients are willing to spend in travel time to obtain medical care.

2. Electronic "travelling"

The problem of geographic mobility is going to become even more difficult to handle as telehealth becomes more pervasive and plays an increasingly important role in rural health care. Broadly defined, telehealth is the use of telecommunications and information technologies to overcome geographic distances between health care practitioners and service users for the purposes of diagnosis, treatment, consultation, education and health information transfer. To date, physician and patient mobility means, with few exceptions, travel from one location to another. In the not-too-distant future, mobility will mean both travelling by car, plane and train and "travel" on the electronic highway.

As telehealth technology becomes more powerful and affordable, interactions over long distances between physicians and patients, as well as between physicians and their colleagues, for medical purposes will become commonplace. Increasingly, face- to-face interactions will be replaced by "virtual" contacts. In a way, telehealth can be seen as a form of mobility, involving long-distance "travelling" by patients to see their physicians or vice versa by means of telecommunications.50 As a result, the shape of rural medical service delivery could be altered substantially.

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Other methods used

1. Distance between physicians and population

Earlier we mentioned 2 major problems associated with using the population-to-physician ratio: the need to adopt an often artificially defined geographic unit of analysis and the assumption that there is no mobility across regional boundaries on the part of service providers and service users. These problems have presented many conceptual and analytical difficulties. For these and other reasons, some researchers interested in the geographic distribution of physicians, as well as other types of health services, have adopted a different approach by using distance between physicians and patients or potential patients as the analytical focus.

When access to medical care is the main concern, a more direct measure, and probably a measure that is more meaningful to most people, is the distance between service consumer and service provider or the amount of time needed to travel in order to access service. The issue is no longer the number of physicians in an area or the number of communities without a physician, but how far an individual has to travel or how much time he or she has to spend on travelling in order to access medical care. Thus, the level of analysis has shifted from the geographic area to the individual.18,51,52 Nonetheless, as explained by Joseph and Bantock,53 these 2 types of measure — population-to-physician ratios and distances between population and physicians —

are complementary. Whereas the former are indicators of broad supply and demand relationships across large regional units, the latter can be used to gauge the variability in potential access within a region.

The how-many-miles-to-the-doctor approach is not entirely new. Using data from the 1971 census, Angus54 and Angus and Brothers55 examined the geographic distribution of physicians in Alberta by using the "proximity of population to physicians" method, which was an attempt to establish a correlation, in terms of distance, between people and the physician closest to them, irrespective of the boundaries of regions or counties within the province. The researchers examined the average distance that populations, using the enumeration area (EA) as a base, would have to travel in order to obtain medical care. The distance was calculated between the centre of the EA and the centre of the municipality in which the physician was located.

Williams and coworkers52 analyzed the distances that rural residents in 16 US states had to travel to receive medical care from various types of specialists and documented changes in physician availability in the 1970s. To estimate the distance to the doctor, they calculated the distance (as the crow flies) between a point corresponding to the centre of each 33-square-mile grid and a point corresponding to the latitude and longitude of the nearest physician of a designated specialty.

Joseph and Bantock53 used a distance indicator to study changes in potential accessibility to GPs/FPs in Bruce and Grey Counties in Ontario from 1901 to 1981. In their study of accessibility of medical services in the Abitibi–Temiscaming region of Quebec, Thouez and colleagues56 also used a measure of geographic access that incorporated the notion of distance between physician and population.

An attempt was made by Ng and colleagues57 to examine the proximity of population to physicians in Canada based on the aerial distance to the nearest physician from a representative point within each of Canada's 45 995 EAs.

In our more recent work2 we re-computed the distances between population and physicians for 1996, using the methodology described by Ng and colleagues.57 In addition, distances between population and physicians were computed, using equivalent data for 1986 and 1991. We observed that the mean and median distances to the nearest physician decreased from 1986 to 1991 and again from 1991 to 1996. These distance trends reflect the increasing numbers of Canadians and the increasing numbers of physicians living in relatively large urban areas. The corollary to this observation is the fact that the distances to physicians for rural residents are increasing. We also observed that a GP/FP working alone in a community (i.e., very rural!) was generally located more than twice the distance from his or her nearest specialist colleague than counterparts who worked in communities with 2 or more GPs/FPs.

The population-to-physician distance methodology, employed by Ng and colleagues57 and us,

suffers from the impact of artificially designated geographical units. Both populations and physicians are given locations by assigning postal codes to the centres of EAs. Distance computations are then made between EA centres. When a distance is computed as zero, this distance measurement is set to 0.5 km to acknowledge the fact that the population is not "living in the physician's office." For urban areas, this default minimum distance is likely to have little impact on the real median or mean distance between population and physicians. However, in rural areas where the EAs are very large, this approach probably underestimates the actual distances. True distances can be determined when and if we are able to obtain the precise locations of every physician and every person in the Canadian population!

2. Using "distance measures" in health service planning

The proximity-of-population-to-physician approach can be and has been used in health service planning. In the US, the Graduate Medical Education National Advisory Committee has recommended that 5 basic types of health services should be available within some minimum time standards: 30 minutes of travel for emergency medical care, 30 minutes for adult medical care, 30 minutes for child medical care, 45 minutes for obstetrical care and 90 minutes for surgical care. The 30-minute travel time for non-emergency medical care has become the standard in health service planning in the US.18 In Canada, the Advisory Panel on the Provision of Medical Services in Underserviced Regions30 has suggested that primary care should be available within 30 minutes, secondary care within 2 hours and tertiary care within 5 hours.

A physician resource planning approach has been developed in Saskatchewan, which assumes that residents will receive a particular service in the closest community where such service is available.58 This approach is referred to as the "closest-to" population analysis. For any particular "closest-to" population analysis, it is necessary to first identify the communities that will provide the service. The next step is to assign the population closest to the provider community in terms of travel time, resulting in the calculation of a "closest-to" catchment area population for each provider community. The specialist supply is then distributed to each provider community in proportion to that community's catchment area population. If only 3 centres (Saskatoon, Regina and Prince Albert) are designated to provide specialist services, 28.7% of the population in 30 districts would have to travel 90 minutes to the closest one of these 3 centres, and 19.7% would have to travel more than 2 hours to the nearest centre. If the number of provider communities is increased to 6 (Saskatoon, Regina, Prince Albert, North Battleford, Yorkton and Moose Jaw), 16.3% of the population would have to travel more than 90 minutes to the closest of these centres. Only 7.5% would have to travel more than 2 hours to the nearest centre.58

Table 2 summarizes the various geographic concepts or measures and their advantages and disadvantages.

Conclusions

The physician manpower pendulum appears to be swinging from a perceived surplus to a perceived deficit. Uneven geographic distribution is likely to be aggravated if there are insufficient physicians to go around. Smaller and more remote communities tend to be the first to feel the effects of an impending physician shortage. Thus, there will be more demands to find out where physicians are located, and our ability to accurately describe the geographic distribution of physicians, as well as to explain it, will be put to test.

We have highlighted in this article the problems facing researchers and how some of these problems have been dealt with. The need to use often artificially defined areal units in analyses is one of the most perplexing problems. This problem exists, to a greater or lesser extent, regardless of which methodology is used. Clearly, there is not a single approach that will serve all research or planning purposes.

We believe that the traditional population-to-physician ratio is a valid general planning tool. However, we also believe that these ratios are too often computed (because it is relatively easy to do so!) with little critical evaluation of what they actually mean in terms of geography. Without this critical evaluation, health care plans and policies designed to deal with rural health care delivery problems may be poorly conceived. Since many programs and policies designed to improve the availability of physicians in rural areas are made on the basis of population-to-physician ratios, it is advisable that researchers who use such ratios in their studies explain what the ratios mean and identify their limitations, with a view to making sure that policy-makers and health services planners are cognizant of the pitfalls of various methodologies and the intricacies in interpreting physician distribution data.

The issue of mobility looms large in how we describe physician distribution. Improvements in transportation have made it more convenient for people to travel to seek or deliver medical care, rendering the notion of static physician distribution unrealistic. As we have pointed out earlier, the widespread use of telehealth is going to be an even greater confounding factor. If travelling on the highway, railway, skyway and waterway has made the task of describing physician distribution more difficult, "travelling" on the electronic freeway will make the situation even more complex. The need to come up with new approaches to conceptualize and measure physician distribution has never been greater.

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Correspondence to: Dr. Raymond W. Pong, Centre for Rural and Northern Health Research, Laurentian University, Sudbury, ON, rpong@nickel.laurentian.ca

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