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FACTORS AFFECTING DISTANCE TO THE NEAREST PHYSICIAN IN CANADA : CHANGES FROM 1993 – 1999

by

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ABSTRACT

Ability to pay for physician services is not a barrier to service in Canada, but travel distance may restrict some people's access, especially in rural areas.

This thesis examines the distance to the nearest physician from a representative point within each of Canada's census enumeration areas in 1999, and the nature and extent of changes in these distances since 1993. The study is based on the 1999 postal codes of the 56,775 physicians in the Canadian Medical Association registry.

Distance to the nearest physician has changed little since 1993; 87% of the population still live less than 5 km from the nearest physician.

Distance to the nearest physician was greater in rural areas and small towns, in less urbanized provinces/territories, at higher latitudes, and in less urbanized low-income areas.

Physicians-to-population ratios also decreased by 6% from 1993 to 1999.

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TABLE OF CONTENTS

Page

LIST OF TABLES

LIST OF FIGURES

Page

Figure

LIST OF APPENDICES

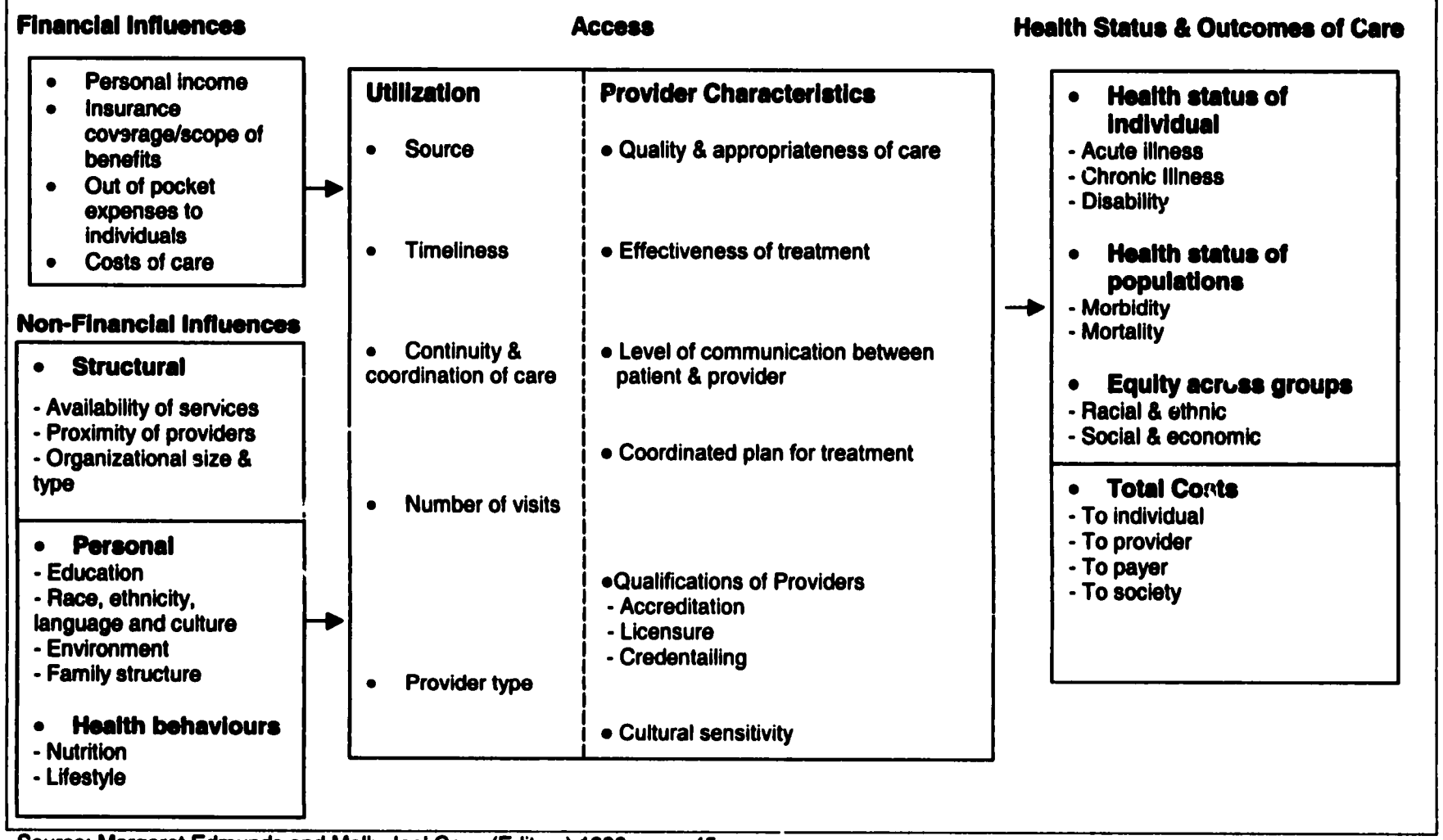
Chapter One

INTRODUCTION

1.1 Background

An overwhelming proportion of the Canadian population view their health care system as an essential part of their national identity and pride (1). This perception could be partly explained by the underpinning of the Canadian health care system – the Canada Health Act, which stipulates that the system should be run by the government on a not-for-profit basis with eligibility to all citizens and equal access to health care. As pointed out by Arboleda-Flórez et al. (2), Edmunds et al (3), Anderson (4) Millman (5), Aday et al (6) and Penchansky et al (7) numerous conceptualizations of access to health care exist. However, the common theme in all the explanations concerns the degree to which people are able to obtain needed services from the medical care system. As depicted in figure 1.1 below, two major factors have profound influence on access to health care. The most obvious of the two factors are financial constraints where inability to pay for services and drugs may prevent people from getting the care they need. In Canada, the organization of the health care system has virtually removed the financial burden to access. Nevertheless barriers to access may be found in the non-financial influences to access. Proximity to physicians is an example of a non-financial barrier to access which is the focus of this thesis.

Figure 1.1: A framework for Approaching Financial and Non-Financial Influences on Access



Source: Margaret Edmunds and Molly Joel Coye (Editors) 1998, page 45.

Health behaviour, personal traits and structural issues are the main factors under the non-financial influences. Of the three factors, the structural characteristics of the health system are of great interest to this project. Proximity of providers as stated in figure 1.1 can be regarded as proximity to the nearest physician (distance) while availability of services could be considered as the supply of physicians in an area (population to physician ratios). As summarised in figure 1.1 several other factors could either hamper or promote an individual's access to care, but these will not be addressed in this thesis.

Although proximity to physicians is not a hindrance to access for the entire country, it may be a barrier, especially in rural areas where some people's access to physician services is restricted by long distance (8, 9). Ng et al. (1997) analyzed distances traveled to the nearest physician from a representative point (see Definitions in Appendix A) within each of Canada's census enumeration areas (see Definitions) using the Canadian Medical Association 1993 physician address registry (10). The study revealed that proximity to physicians varied inversely with average income in less urbanized and rural areas. The study also found that most Canadians in the southernmost parts of the country did not have to travel more than 5 kilometres (km) to see a physician. However, in the northern parts of Canada (north of latitude 55°) nearly two-thirds of the population were 100 km or more from the nearest physician. This issue is an enormous health policy challenge

in a country such as Canada due to its size and sparse population north of latitude 55°.

1.2 Aims and Objectives

The main aim of this study is to identify any changes that may have taken place over a recent six-year period in the distances people have to travel to the nearest physician. Other objectives include:

- To classify census divisions (CDs –see Appendix A) into "well-served" and "under-served" areas, based on physician-to-population ratios[1].
- To compare and contrast the socio-economic characteristics of "under-served" and "well-served" areas.
- To compare proximity and physician-to-population ratios as indicators of physician access

Proximity to physicians and population to physician ratios were used in this study because as discussed in section 2.4 these indicators are complementary and tend to measure the same thing but from different directions. Proximity addresses accessibility while ratios focuses on the availability of physicians.

[1] Refers to the number of physicians in an area compared to the population in that same area. Expressed per 100,000 population in this study. In general higher ratios implies "more adequate" or at least "more" physicians in an area.

1.2.1 Expectations:

Although major emphasis will not be placed on testing hypotheses due to the descriptive nature of this study, it is expected that;

- The socio-economic characteristics in "under-served" areas may be lower than that of the "well-served" areas.

1.3 Significance of Study

Several studies have in the past documented the uneven distribution of physicians in rural and other non-urban locations (11, 12, 13, 14, 16) in terms of physician-to-population ratios. This study does not intend to follow the same path. Rather, it is an attempt to examine the geographical distances people have to cover to access physician services and the specific location characteristics associated with the distribution of those distances. It is envisaged that this information will be especially relevant to rural areas of Canada. In addition, the results of this study can serve as evaluation benchmarks to assess the effectiveness of policies meant to address travel distance to physicians.

The six-year period between 1993 and 1999 was chosen because the 1999 Canadian Medical Association physicians' data were the most currently available data at the beginning of the study. It was also felt that six years was long enough for changes to have occurred since the Ng et al (1997) study. No

major steps have been taken to address the concerns of the Ng et al study, but it was reasonable to assume that data from the ensuing six-year period might provide more convincing information to alert governments to this important problem or to stir governments to action.

The present study differs from the major studies on distance to physician services in Canada (10, 15, 16), because unlike its precursors it focuses on a six-year period rather than a snapshot picture. Thus this study provides a broader picture of the subject being studied. However, although the six-year time period provides valuable information it cannot really be considered as trend data on proximity. This is because any pattern revealed between 1993 and 1999 may perhaps be part of a broader trend, which has not yet been uncovered. The need for further research on this issue is therefore justified. This is why the present study should be replicated in 5-10 years time, to help provide a more complete picture to the concerns addressed in this study.

Secondly, this study differs from earlier projects in that it classifies areas (at the census division (CD) level, see Definitions) as either "under-served" or "well-served" based on "population-to-physician" ratios. This categorization is entirely new and was done to assess relative access to physician services. In addition, this project goes beyond presenting differences associated with geographic variables (latitudes, province) to highlight, describe and contrast socio-economic characteristics between "under-served" and "well-served" areas.

Thirdly, unlike Ng et al, the current study compares the physician-to-population and proximity to physician approaches to physician supply. A correlation coefficient was calculated to assess the relationship between the two measures. Other differences were the modifications done to the grouping of latitudes and the calculation of Income Per Person Equivalent (IPPE, see definitions).

1.4 Structure of Project

The foregoing discussion has provided a background to the rationale, aims and objectives of this project and the significance of pursuing such a project. Chapter two will provide a review and synthesis of previous studies that relate to distance to physician services. The search strategy used in identifying these studies will also be presented.

Chapter three will focus on the methods and the sources of data used for the study. A detailed description of the measures used to analyze the data will be provided. Also, a discussion on how "under-served" and "well-served" areas have been categorized in various jurisdictions and how this concept will be conceptualized in this study will also be provided. The fourth chapter will present the study results, identifying trends and patterns. The socio-economic characteristics of "under-served" and "well-served" areas will also be presented. The final chapter will discuss the results and their implications, and the limitations of the study. Conclusions from the study and

recommendations for future research on issues related to physician services and travel distances will also be discussed in this chapter.

Chapter Two

REVIEW AND SYNTHESIS OF LITERATURE

The purpose of this chapter is to present an overview of existing research on the proximity of physicians to the population they serve. Thus this chapter will focus on what is already known about travel distances to access physician services and on the design of these earlier studies. A description of the methods used in the literature search, selection and review process will also be presented.

2.1 Overview

An extensive array of research exists on a varied number of physician supply issues. Some of the themes that have been of interest to researchers are the spatial distribution of physicians, the number and supply of physicians, the changing demographic structure of the physician workforce, recruitment and retention of physicians (especially in rural areas), and appropriate physician-to-population ratios. Physician training and licensing requirements, especially for foreign trained physicians wishing to practise in Canada, have also been addressed by various expert groups at both provincial and federal levels of government. As will be evident from the search for relevant material for this topic, studies on distance traveled or proximity to physician services are

relatively few. Thus, while quite a broad strategy was used to identify and gather information, a relatively small number of studies were useful for this project. The paucity of studies and the importance of this area of research influenced the choice of this topic as a project of inquiry.

2.2 Search Strategy

The initial step in finding material for this project was to identify and classify relevant studies for further review. A list of key words (see appendix B) was developed, relying heavily on examples from previous studies. A Medline and Healthstar (now merged with Medline) search was done using the key words, covering the period 1966 to October 2001. As well, Health Canada's electronic library catalogue system which is linked to the Canadian government research documents was searched to uncover pertinent unpublished documents and task force reports at both federal and provincial level. The Canadian Medical Association and the Royal College of Physicians and Surgeons of Canada (RCPSC) were also contacted for this same purpose. Furthermore, the reference sections of previous articles, reports and books on this topic were reviewed for relevant material. Additionally, a number of experts in this field of research were contacted. Finally, the Internet was searched using a range of search engines for possible discovery of material that appears on the Internet rather than in print format. A systematic review was not done in reviewing material for this study because the study topic is not clinically focused as in assessing the effectiveness of clinical

interventions rather it is a descriptive study of one aspect of access to physicians.

2.3 Literature Review

The earliest relevant Canadian study on distance to the nearest physician dates from 1976. In their study, Angus and Brothers used the Alberta Medical Manpower Data File covering the period 1963-1972 and the 1971 census to study the proximity of Albertans to their physicians (17). One of the major objectives of their study was to improve on the conventional methods (physician-to-population ratios) used to analyze the relationship between populations and physicians. They argued that "the proximity to physician method allowed for the relationship between doctors and people to be calculated at a much more detailed level of disaggregation" (17, page 382).

Angus and Brothers used a special Universal Transverse Mercator Coordinate System (UTM) to calculate the average distances between the centre (representative point or centroid- see Definitions) of an EA and the centre of the municipality where physician services were assumed to be located. EA was used in this study because they comprise only 500 people, which represents the smallest level of disaggregation in summary census data files. The results were presented at the CD level and it was evident that in 1971, most people in Alberta's 15 CDs were able to obtain the services of general practitioners and general surgeons within their respective CDs.

In 1983, Williams and his colleagues sought to determine how far the rural population in 16 states of the United States lived from different types of specialized medical care (18). Williams et al. were also interested in knowing whether distance traveled to receive medical care had changed since the 1970's. Other objectives were to determine whether there were variations in distance to medical care in the various rural regions of their study area. These researchers used the 1970 and 1979 American Medical Association's Master File of Physicians and the 1970 US population census as their sources of data. To make the distance calculations to the various specialists meaningful, Williams et al. reduced the number of specialty groups in the master file to seventeen by amalgamating similar groups. They used enumeration districts (equivalent to EAs in Canada) and block groups (equivalent to census tracts) as the basis of their analysis. In estimating the distance to the doctor, Williams et al. developed a program that calculated distance (as the crow flies) between a point corresponding to the centre of each 33-square-mile grid (the reason behind the choice of this grid is unclear) and a point corresponding to the latitude and longitude of the nearest physician of a designated specialty (18, page 959). Their study revealed that "in 1970, only 13 rural residents in 100 lived more than 10 miles (16 km) as the crow flies, and only 2 in 100 lived more than 20 miles (32 km), from a practicing physician in the 16 states they examined" (18, page 961). In addition, it came to light that actual driving distance averaged about 20 to 25 percent longer than the straight-line distances calculated in the study. Also the study

discovered that between 1970 and 1979, there were reductions in the distance to a physician for virtually all specialty groups. They also observed that by 1979 approximately four-fifths of the rural population were within 20 miles of specialists in internal medicine, general surgery, obstetrics/gynecology and pediatrics, and fewer than 5 percent were more than 50 miles (80 km) from such specialists (18, page 961). The study clearly showed that the greater the percentage growth in a specialty the greater the improvement in access to the services of that specialty group, compared to the situation in the early 1970s.

Joseph and Bantock used population data at the EA level from the 1976 census and local District Health Council survey data on the location of general practitioners (GPs) to carry out a study in Wellington County in Southern Ontario (19). Their study was based on the premise that given the importance of physical accessibility to GPs for the functioning of rural health care systems, there was a clear need to be able to measure accessibility in a simple and unambiguous manner. An index was therefore developed to facilitate the calculation of potential physical accessibility to GPs. The distances were measured between the EA centroids (see Definitions) and where the GP office was located. The results of their study suggested a relatively greater availability of GPs than expected in a rural area since the settlement pattern of the study area and associated distribution of GPs were reasonably well developed (urbanized). They argued that, "although considerable differences in potential accessibility exist between rural areas

and urban centres, the smaller catchment populations of most rural GPs may partly compensate for isolation from major, urban concentrations of physicians" (19, page 85). Again in 1984, Joseph and Bantock used data from five censuses and several medical directories to study trends in the patterns of access to GP/ Family Practice (FP) in the Bruce and Grey counties of Ontario (20). Their study covered an 80-year period from 1901 to 1981 and evolved out of the idea that substantial changes had occurred during the 20th century in spatial organization of rural areas and in health care delivery systems. These changes they argued needed to be assessed to determine their impact on the patterns of access for GP/FP. They used a distance indicator similar to the measure used in their earlier study to examine potential accessibility to GP/FP. The study revealed that there had been a decline and a centralization of GP/FP services in the counties of Bruce and Grey over the study period (20, page 226). They concluded that increases in mobility of the dispersed population in the area had only partly offset the negative impact of the changes they observed. They stressed that individual rural localities fared differently, based on their location relative to the central place network[2].

Using methods similar to those of Joseph and Bantock, Thouez et al. in 1988 studied accessibility of medical services in the Abitibi-Temiscaminque

[2]Based on the central place theory. A central place is defined as an urban centre or settlement node whose primary function is to provide the population of the surrounding area with goods and services. Central place functions are therefore essentially distributional and are dispensed from a central place to customers who are spatially scattered (19, 20). The theory tries to explain the number, location, size, spacing and functions of settlements within an urban system (21, 22). An example of this could be the services Ottawa provides for the surrounding towns and villages.

region of Quebec, for the period 1973 to 1982 (14). The purpose of their study "was to report on a specific geographic response to the challenge of measuring access" (14, page 34). Their measure of geographic accessibility expanded on Joseph and Bantock's index to incorporate the concept of potential spatial effectiveness. These authors claimed that "the fundamental task for introducing the potential spatial effectiveness measure was to assess quantitatively the overall degree of spatial separation within a region (made up of several communities within distinct locations) between the supply of medical care and potential demand for that care" (14, page 37). The datasets for the study were obtained from the Medical Association of Quebec (physicians by location and specialization) and the 1981 census of municipal populations. Maximum travel distance over which a physician contributed to the accessibility of a community was set at 50 km. Their study uncovered that between 1973 and 1982, there was an improvement in the potential accessibility to GP/ FP services in the region. They claimed this was due mainly to the increase in the number of GPs (103 in 1982 compared to 45 in 1973, an increase of 126 percent), rather than a reallocation of existing physician supply. In the case of specialists they concluded that the relative improvement in potential access was somewhat less marked than in the case of GPs, because there were fewer settlements with specialists (from 7 to 6 settlements) over the nine-year study period despite a 42% increase in the number of specialists (from 26 in 1973 to 37 in 1982) in the region (14).

In 1993, Ng et al. used similar methods to study how far the nearest hospital was, in each of the existing 44,042 census EAs in Canada existing at the time (15). As will be seen in the ensuing discussion, the methods used in this study were similar to those used in other studies on proximity to health care services. Ng and his colleagues set out to demonstrate how to calculate distances between points described in terms of latitude and longitude. Using Statistics Canada's 1991 Postal Code Conversion File (PCCF) and both the 1986 and 1991 Geography Attributes Files, as well as the 1990 List of Canadian Hospitals, the researchers were able to calculate aerial (straight line) distances between the EA area centroids for the population and the block face or EA centroids for all hospitals in Canada (15). The population counts for each EA were obtained from the 1986 Geography Attributes File. The study revealed that the median aerial distance to the nearest hospital facility in Canada was less than 3 km, while the mean distance was about 6 km. Since hospital facilities were categorized according to their type, size and location it was also discovered that the median aerial distance for teaching hospitals was a little less than 30 km, while the mean distance was a little more than 90 km (15, page 179). As expected there were provincial differences in the median, mean and distribution of the population's distance to the nearest hospital.

In 1997, Ng and others examined how far the nearest physician was from the Canadian population. The goals and methods of this study were quite similar to their earlier study, although in this case their analysis was

more comprehensive. The results of this study were presented by community size, EA income, latitude north, specialty and province or territory (10). The summer 1993 Canadian Medical Association Master List and the 1991 Census data on the 45,995 EA's were used for this study. The study showed that in 1993 nearly 99 percent of residents in large urban centres (with one million or more people) were less than 5 km from the nearest doctor. In contrast, only 56 percent of the population outside of urban centres (50,000 or more inhabitants) lived less than 5 km from the nearest doctor. In essence, the smaller the community, the farther the distance to the nearest doctor. The study also highlighted the fact that 87 percent of the population was less than 5 km from a physician, since the majority of Canadians lived in urban areas. As well, proximity to physicians varied directly with average area income in less urbanized and in rural areas, but not in more urbanized areas. Furthermore, the study found that while Canadians in the southernmost parts of the country enjoyed very short distances to a physician, in the northern latitudes physicians tended to be much farther away. As in their previous study, provincial and territorial differences were present, with the more urbanized provinces (e.g. Quebec, British Columbia and Ontario) having shorter distances to the nearest physician. In terms of specialty, the analyses showed that the smaller the number of physicians in a specialty, the greater the distance to the nearest specialist.

The latest and the most comprehensive study in terms of its review of the literature on geographical distribution of physicians and proximity to

physicians in Canada is the Pitblado and Pong study commissioned by Health Canada in 1999 (16). The study covered the period from 1986 to 1996, and although its objectives were varied, the most relevant in the present context was its goal of enumerating and mapping the locations of Canada's physicians, using some of the various methodologies that have been used to study proximity and physician distribution. Pitblado and Pong used the Southam Database for years 1986, 1991 and 1996, the 1991 National Physician Database from eight provinces, the PCCF and the 1986, 1991 and 1996 Censuses of Canada as their data sources.

As noted by the authors "adopting the procedures of Ng et al, each physician was assigned the latitude and longitude of the representative point or centroid for the nearest EA (rural area) or the block-face (urban area) (see Definitions) that corresponded to his or her Southam Database (SMDB) postal code" (16, chapter 3, page 3). After mapping the practice locations of the 54,958 physicians in Canada in 1996, Pitblado and Pong concluded that physicians were not evenly distributed and that this uneven distribution was particularly acute with respect to specialist physicians in rural and remote areas of the country. They further observed that while the majority of Canadians continued to live in close proximity (less than 5 km) to physicians and hospitals, the distance to these health personnel and facilities was increasing for rural residents as physicians and hospitals were increasingly concentrated in urban and urban fringe areas (16, chapter 4, page 3).

Other studies by advisory committees such as the Graduate Medical Education National Advisory Committee in the United States (GMENAC) that set standards on travel-time-to-service should be noted. Unlike the studies discussed above, the work of these expert panels was mainly to provide appropriate guidelines on minimum travel times to access health services. As pointed out in Jacoby (23), the GMENAC recommended that five basic types of health services were to be available within the following minimum time/access standards. Thirty minutes was stipulated as the maximum travel time to emergency medical care, adult medical care and child medical care, whereas forty-five minutes was the standard for obstetrical care and ninety minutes for surgical care services. While the committee acknowledged that their standards might in some circumstances be "impossible to achieve for all areas [they] should at least apply to 95 percent of the American population" (23, page 429). It should be noted that, the above time-to-service standards were chosen based on extensive review of literature and the consensus judgements of health services experts. The most plausible purpose for standards like those proposed by GMENAC is to help locate health services more appropriately in rural areas.

2.4 Physician Proximity compared to Physician-to-Population Ratio Approach

The distance to physician and the physician-to-population ratios approaches to analysing the relationship between physicians and populations are

complementary (16, 20). This is because both approaches try to assess the same phenomenon but from different angles. Physician-to-population ratios are generally indicators of broad supply and demand relationships across large regional units, while the distance between physician and population measure can be described as a guide to gauging the variability of potential access within large regions (16, 20).

As noted in the National Ad Hoc Working Group on Physician Resource Planning report, physician-to-population ratios have been used as a principle indicator for physician resource planning in Canada for some time (24). The report indicates that their application can be traced as far back as the 1964 Royal Commission on Health Services (24, 25, 26). The popularity of this ratio stems from its simplicity and minimal data requirements (24, 25). The National Ad Hoc Working Group on Physician Resource Planning reported in its survey that 9 of the 10 provinces employed this ratio in their planning activities.

Since both methods measure the same phenomenon, they have common conceptual and analytical problems. Some of these issues are addressed in this review. Both the proximity and physician-to-population approaches present an oversimplified and sometimes even misleading image of the relationships between physicians and the population they serve. Implicit in the use of physician-to-population ratio is the often artificially defined geographic unit of analysis, and the assumption that there is no mobility across jurisdictional boundaries for either patients or physicians (25, page

111). Also the notion that people will gladly obtain care from the nearest physician (proximity approach) is unrealistic. In actual fact, many people obtain their health care services outside of the region in which they reside (27).

Also both approaches do not adjust for differences in population needs (as determined by risk and morbidity factors), thus providing little insight into the dynamics and determinants of demand. Moreover, provider substitution (physicians providing services of other specialties, e.g. GPs providing obstetric and gynecology care) is often discounted in the calculation of the physician-to-population ratios. This can lead to a narrow focus on single specialty categories, which discourages examining the adequacy of the physician mix available in a particular area.

In addition, both methods' emphasis on supply of physicians may lead planners to neglect the potential for making improvements in areas like productivity, and the use and relevance of services. Also both methods do not address critical mass[3] issues, and may indicate an adequate supply in an area when in reality the physicians practicing in the area may not reach the critical number required for a viable practice. Lastly, both approaches assume that all physicians provide services in equal quantity and on a uniform basis, which is inaccurate. The impact of variations in physicians' characteristics (e.g. physicians working less than full time as clinicians) becomes important

[3] Critical mass refers to the minimum number of physicians in a particular specialty required within a given geographic region to allow for acceptable provision of services to patients, as well as adequate professional support for one another.

when comparing smaller cohorts of physicians against national proximity guidelines (if available) or physician-to-population ratios.

It is fair to conclude that the challenge of determining the adequate number and mix of health professionals for a given area or population that has claimed the attention of researchers and health policy-makers for decades (28), will continue to do so until appropriate alternative measures are found. It should, however, be pointed out that even though proximity guidelines and physician-to-population ratios are far from perfect measures of population need and physician supply, they do provide a useful benchmark for comparison, especially in regard to relative access to health care services (29, 30, 31).

Finally, the proximity to physician approach was chosen as the main theme for this study, because it overcomes some of the major limitations of physician-to-population ratios discussed above (artificial boundaries) and provides more information on potential access to physicians. It should however be noted that neither approach is perfect.

2.5 "Under-Served" and "Well-Served Areas"

Health policy-makers and researchers have used a plethora of terms to characterize the distribution of physicians. "Medically under or over-serviced" area, "under-served" and "well-served" area, "critical medical shortage" area, "geographic imbalance" and "mal-distribution of physicians" are a few examples. The common theme in all these terms involves the comparison of

an observed or actual distribution of physicians in a particular jurisdiction with some standard that can be defined as "ideal" or "optimal". As stressed earlier, "the problem with identifying an area as 'well-served' or 'under-served' by comparing physician-to-population ratios with an optimal ratio is that nobody seems to know how to objectively set an optimal ratio that accurately reflects local medical care needs" (16, chapter 2, page 23).

In Ontario, the Ministry of Health's Under Serviced Area Program requires the assessment of several factors in addition to population to physician ratios to designate an area as "under-serviced". These factors include population size and structure, financial impact analysis, previous recruitment efforts, socio-economic status of the area, local demand for services and additional health service needs and resources (32).

Likewise the 1992 Canadian Medical Association Advisory Panel on the Provision of Medical Services in Under-Serviced Regions (12), recommended that "for the purpose of medical resource planning, an 'under-serviced region' should be defined as a geographic area where access to local health services is justified by the population but where such services have not or cannot be maintained consistently. The guideline for temporal access referred to above should be used to identify such areas" (12, page 35). With regard to temporal access to the various levels of care, the Panel suggested that primary care should be available within 30 minutes, secondary care within two hours, and tertiary care within five hours (12, 16).

Similarly, various measures of "under-service" exist in the United

States. For instance, the US Bureau of Health Manpower has defined a Critical Medical Shortage Area as an area that has a ratio of resident population to full time equivalent non-federal, primary care physicians greater than 4,000:1 (16, 33). Other designations like Health Professional Shortage Area are used to identify locations in which to place physicians under the National Health Service Corps Program. Under this program, a county, a sub-county unit or an aggregation of counties is seen as under-serviced if the population to primary care physician ratio in the area is greater than 3,500:1 (16, 34).

Another widely used label is the Medically Under-served Area (MUA), which the US federal government uses to identify areas where health maintenance organizations could receive federal assistance. The Index of Medical Under-service (IMU) is the mechanism for determining MUA status. The IMU is considered to be a more sophisticated index than the conventional population to physician ratio since it attempts to measure under-service by considering both medical care demand and supply (16, 35, 36). The IMU consists of four variables: infant mortality rate, physician per population ratio, percent of population age 65 and over, and percent of the population below the poverty level. The IMU score for an area is the weighted sum of the values for each factor. Values of the index range from 0 to 100, with lower scores indicating higher levels of medical under-service (16, 35, 36).

The Ontario Ministry of Health and Canadian Medical Association classification of under serviced areas could have been used in this project, if

all the required information on CDs were available.

The above discussion has provided an insight into the research available on the proximity approach to physician services and the various terminologies used to describe the distribution of physicians.

2.6 Synthesis of Literature

Studies on distance to the nearest physician present a different light on physician access than the more usual studies of physician supply (physician-to-population ratios) which focuses solely on physician availability.

The studies reviewed are all based on the assumption that all physician services are of equal quality and also that apart from needing emergency care people will be willing to use the nearest physician. This may not be true since subjective factors like personal satisfaction, endorsements from friends, family tradition and daily commuting patterns among others may be more important than proximity to the nearest physician. Although actual travel distances may in reality differ profoundly (where physical barriers like water bodies exist) from the crude estimates derived in the above studies, the utility of this approach lies in the fact that it provides a way for estimating the *minimum* distance that people are traveling to access physician services. Likewise it also raises questions on the influence of long travel distance on health care utilization rates and health outcomes. Thus are people postponing or reducing the number of trips to physicians and what are consequences of this on health outcomes?

Chapter Three

METHODS AND DATA SOURCES

This chapter will focus on the sources of data and methods used for this project. An explanation of how "under-served" and "well-served" area is conceptualized in the study will also be provided.

3.1 Sources of Data

Census 1996: Population counts and income data were derived from the 100% data ("short-form" questionnaire) and the 20% sample ("long-form" questionnaire) respectively. Other demographic and socio-economic characteristics associated with CDs were also examined. This was done to provide a better profile of the CDs (counties or equivalents) that would be classified as "under-served" or "well-served" in the course of the study.

Virtually the entire population was coded to an EA, although a negligible portion (.04%; 12,723 out of 28 million), which could be people living in EAs with very small populations (data suppressed for confidentiality reasons) or in EAs with only institutional residents (for whom no income data are routinely collected), could not be assigned to an income quintile.

Canadian Medical Association Physician Master File: Attempts at developing a national physician database began in the late 1970's and have since evolved into the Association's Physician Master File, which is updated on a daily basis to ensure accuracy (24, 37). Other strengths of this database are its inclusion and exclusion criteria (discussed below). The 1999 physicians' data were used because they were the most current available dataset at the beginning of the study. Several physician databases have been developed in Canada for different purposes with varying methodologies and diverse inclusion and exclusion criteria. The tendency for databases to differ in the tracking of physicians is therefore very real and needs to be addressed in the interpretation of results arising from the use of any of these databases. This explains why the Association's dataset was used again for this study. Using a different physician dataset could have prevented comparisons since different data compilation methods are used for different datasets. Extracts from the 1999 physician master file, with the postal codes for all 56,775-physician practice addresses, served as the main data source for this project. The Canadian Medical Association Master file contains records of all physicians who are, or have been, licensed to practice in Canada, regardless of whether they are members of the association, and is maintained separately from the organization's membership information (24, 37, 38). The data include the age, sex, address, specialty and practice status (active, semi-retired, abroad, retired). The database excludes those over the age of 80 and categorizes physicians by their qualifications and certification. The 1999 Canadian

Medical Association physician specialty grouping was slightly different from the 1993 list. Two new specialties, namely therapeutic radiology and medical scientist were added to the list. In addition, some sub specialty categories were merged into larger specialty groupings. For instance, pediatric cardiology was merged into cardiology, vascular surgery and pediatric general surgery were added to general surgery, and public health became community medicine (see [notes under] appendix D).

All physician records could be coded to a community and hence to an EA, but 0.7% (326 out of 56,775) of these records could not be coded to an EA income quintile. To facilitate the classification of areas as "well-served" or "under-served" physician records also had to be coded to CDs. Only 100 (0.2%) out of the 56,775 records could not be coded to a CD due to incomplete, inaccurate or missing postal codes.

3.2 Study Design

This study is descriptive rather than analytical in orientation. It uses comprehensive administrative datasets to analyze distance traveled by Canadians, especially those living in rural areas, to physicians. The data provide a means of quantifying access to physician services. For instance a large CD could have all its physicians concentrated in a small area leaving many people far from a physician. In such a situation only a proximity analysis would be to unravel accessibility problems. Also, despite certain limitations, the use of administrative data provides one with the opportunity of using large

data sets that cover entire populations, making inadequate sample size a non-issue (39).

3.3 Analytical Techniques

The methods employed in this analysis are very similar to those used in the 1993 and 1997 studies undertaken by Ng et al. Distance to the nearest physician could not be calculated for each individual. This is because Statistics Canada's techniques for assigning geographic identifiers (Geocoding - see Definitions) are not applied at the individual level. Moreover, calculating distance from each person to the nearest physician would be an expensive project with enormous confidentiality and privacy hurdles. Access to such a database, if it existed, is highly doubtful. Rather, small geographic areas known as census EAs were used. Each EA has a representative point (see Definitions) that was used to represent the location of all EA residents. The latitude and longitude of each EA representative point were obtained from the 1996 GeoRef Files of the Geography Division of Statistics Canada (40).

It was assumed that the physician postal codes reflected the location where physician services were provided. Then, using the Postal Code Conversion File (PCCF) and Version 3D of the Geocodes/PCCF software (also known as PCCF+)[4], each physician was assigned the latitude and

[4] Geocodes/PCCF consists of two SAS programs (GEORES3x for residential coding, GEOINS3x for office coding) and a series of reference files derived from the Statistics Canada PCCF, the Weighted Conversion File (WCF) and other sources (42). The software

longitude of the representative point for the EA or block face that corresponded to his or her mailing address postal code (10, 41, 42, 43). In instances where postal codes referred to a post office box or rural post office, slightly different methods were used because a single postal code can match several EAs (41, 42). With regards to rural postal codes, the EA with the highest population was selected, along with the latitude and longitude of its representative point. It was assumed that a physician's practice was more likely to be located near the centre of the settlement, rather than in an outlying area served by the same rural postal code. For urban post office boxes, all the postal codes within a given Forward Sortation Area (FSA) were considered. (The FSA is the postal service area represented by the first three characters of the postal code.) The weighted average latitude and longitude of the representative points for all the EAs within the FSA were calculated and used to approximate the physician's location. Given the limited area served by most urban FSAs, this approximate location was usually no more than 1 km from any possible point in the FSA.

Aerial, "as the crow flies" distances from each EA representative point (centroid) were calculated to the representative point of all physicians in the same province, using the following equation from Ng et al. (1997):

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package automatically assigns a full range of geographic identifiers such as province, census division, census subdivision, census tract, and longitude and latitude to areas based on postal codes (42).

$$D=6{,}370{,}997*\arccos(\sin(LAT1)*\sin(LAT2)+\cos(LAT1)*\cos(LAT2)*\cos(LONG1-LONG2))$$

Where

D	= distance (in metres)
LAT1	= latitude of point 1 (in radians)
LONG1	= longitude of point 1 (in radians)
LAT2	= latitude of point 2 (in radians)
LONG2	= longitude of point 2 (in radians)
arcos	= arc cosine
cos	= cosine
sin	= sine
6,370,997	= radius of the earth (in metres)

These measurements are actually "great circle" distances or the shortest direct route along the surface of the earth between two locations (15). Where the estimated distance was less than 0.5 km, 0.5 km was arbitrarily assigned as the distance. As in the study undertaken by Ng et al., this was done to eliminate distances of 0 km, which would occur when both physician and population were assigned the same representative point, as would often happen outside of urban centres when the physician and population were coded to the same EA. The shortest of all distances to a physician's office within the same province was then selected. Mean and median distance to the nearest physician were calculated, weighted by the population living in each EA. As in the Ng et al. study, emphasis was placed on the median distance, although mean distance was also provided as a supplementary measure (see appendices C to G). Also the percentage of the population less than 5 km, 5-24 km, 25-49 km, 50-99 km, and 100-149 km to the nearest physician were presented to provide a clear distribution to supplement the

mean and median travel distances, the categories are arbitrary and were chosen to be consistent with the Ng et al. With regards to the accuracy of reporting the results of this study, one decimal point was used as in the Ng et al study, for uniformity.

Distance to the nearest physician was tabulated at several geographic levels. EAs were categorized by province or territory, community size (see Definitions) and latitude. Community size was defined using census metropolitan area and census agglomeration (CMA/CA) populations. Based on this definition, five classifications of community sizes were defined: those with 1,000,000 or more inhabitants, 500,000 - 999,999, 100,000 - 499,999, 10,000 - 99,999 and non-CMA/CAs below 10,000 inhabitants. These categories are based on Statistics Canada definitions and are the same as those used in the Ng et al study. All CMA/CA areas are considered urban areas by Statistics Canada.

Latitude north was classified in 5° bands as follows: 40 - < 45° (e.g., south western Ontario, Toronto, Halifax); 45 - <50° (e.g., St. John's, Saint John, Montreal, Ottawa, Winnipeg, Vancouver, Victoria); 50 - < 55° (e.g., Regina, Saskatoon, Calgary, Edmonton); 55 - <60° (e.g., Churchill, Fort McMurray); 60 -<65° (e.g., Whitehorse, Yellowknife); 65-<70° (e.g., northern parts of the Yukon and middle parts of the Northwest Territories); 70°+ (northernmost part of the Northwest Territories). These classifications differ slightly from those used in the Ng et al study, because they are more precise and less ambiguous than those used in the Ng et al study.

In order to analyze the effects of EA income on distance to the nearest physician, EAs were classified as being in either "more urbanized" CMAs and CAs (all settlements with a population of 50,000 or more) or "less urbanized/ rural areas[5]" (generally smaller CAs and non-CMA/CA areas - settlements with population of less than 50,000) (see Definitions). The 50,000 cut off point was used in order to achieve comparability with the Ng et al study. The above classification was redone using the Statistics Canada yardstick of 10,000 or more for "more urbanized" and below 10,000 for "less urbanized/rural". The reclassification was done to ascertain whether the benchmark population of 50,000 used in the Ng et al. study was inappropriate and had therefore concealed the effects of EA income on distance traveled to the nearest physician.

After the above classification was done, EAs in both groups (more urbanized and less urbanized/rural areas) were ranked separately by income and classified into five "area-based" income quintiles. EA income was based on a derived variable from the 1996 census, Income Per Person Equivalent (IPPE), which takes into consideration the economies of scale possible when two or more people share a household (see Definitions).

3.4 Framework for Classifying "Under-Served" and "Well-Served Areas"

Despite the pitfalls outlined in chapter two (section 2.5) about identifying areas as "under-served" or "well-served" the classification provides a general

[5] Area refers to EAs.

guideline for assessing the relationship between populations and physicians in any area. In this study the terms "under-served" and "well-served" areas were used only to imply relative access of physician services in Canada's 288 CDs.

The dichotomy between "under-served" and "well-served" area was assessed in two stages. CDs were first classified as urban or rural to avoid confounding of other association by urban-rural status: urban areas referred to CDs with 50,000 or more people while the opposite was the case for rural areas. Classification was based solely on population (as done by Statistics Canada); it is recognized that "urban" might be quite rural in character because of the wide expanse of the area, especially after recent amalgamations. The 50,000 population benchmark was used because it helped categories CDs somewhat evenly. The Statistics Canada's urban and rural designation of at least 100,000 and below 10,000 population respectively would have resulted in a one sided classification. Using the above benchmark 111 urban and 177 rural CDs were obtained. The United States Department of Health and Human Services also uses the 50,000 population benchmark to classify counties as urban or rural (44).

Physician-to-population ratios were then derived for all CDs. The ratios were compared to the recommendations of the 1985 Federal/Provincial Advisory Committee on Health Manpower (45) and the more often used 1988 National Specialty Physician Review (46) of the Royal College of Physicians and Surgeons of Canada (RCPSC) "benchmarks". The RCPSC ratios were

developed to determine whether the recommended ratios of the Federal/Provincial Advisory Committee on Health Manpower were appropriate or needed modification (45, page 1). Two sets of ratios emerged, one based on the number of active physicians in 1986 ("Active") and the other on the number of active physicians plus the perceived shortfall ("Active + Shortfall"). As depicted in table 3.2, there are major discrepancies between the Federal/Provincial Advisory Committee on Health Manpower and the National Specialty Physician Review recommended ratios. This is partly because the base years used for these ratios are different. The National Specialty Physician Review ratios are the most current. Therefore with the exception of the ratio for GP/FPs (not regarded as specialists) the classification of areas as "well-served" or "under-served" was based on the National Specialty Physician Review ratios. In instances where the perceived shortfall in a specialty was not included in the calculation of the recommended ratio (e.g. obstetrics and gynecology), the provided "Active" ratio was used as the yardstick (although this may or may not meet population needs).

Although the recommended ratios of the Federal/Provincial Advisory Committee on Health Manpower (45) and the National Specialty Physician Review (46) are portrayed as physician-to-population ratios (tables 3.1 and 3.2), a closer look will reveal that they are actually "population-to-physician" ratios. In order to be consistent with the results of this analysis, the ratios were "inverted" as displayed in table 3.3. This table was then used to further classify CDs by percentage of recommended physician-to-population ratio in

each specialty.

CDs with ratios above the recommendations were classified as "well-served" and vice versa where the reverse was true. Thus emphasis was placed on providing a snapshot as to whether a CD met the recommended standards or not.

The ten "best-served" CDs and ten "worst-served" CDs within the urban and rural strata were selected for comparison. This was done to examine the socio-economic factors associated with physician supply. The comparison was done within strata because it was clearly evident that rural CDs were relatively "under-served", which meant that comparing them to urban CDs (which were generally "well-served") would not reveal any new information. This decision was taken after the results of the comparisons were reviewed.

To provide an unbiased comparison of the ten "best-served" CDs and ten "worst-served" CDs within rural and urban areas, all CDs with medical schools were excluded. This was done because the presence of a medical school was an extraneous factor that guaranteed a good supply of physicians.

Using CD populations as weights, weighted averages were calculated for the selected socio-economic characteristics of the "best-served" and "worst-served" CDs.

This chapter has provided an overview of the data sources and analytical methods of this study. A description of how "under-served" and "well-served" areas were defined in this study was also presented.

Table 3.1: 1980 Target Physician Requirements

	1980 Target Phys./Pop. Ratio - Canada	1980 Target Physician Requirements - Canada (#'s of physicians)
GENERAL/FAMILY PRACTICE	1:1,307	18,535
MEDICAL SPECIALTIES		
Internal Medicine	1:8,166	2,967
Dermatology	1:77,098	314
Neurology	1:89,948	269
Pediatrics	1:19,355	1,252
Physical Medicine	1:113,758	213
Psychiatry	1:10,232	2,368
Public Health	1:131,856	184
Anesthesia	1:13,805	1,755
SUBTOTAL		9,322
SURGICAL SPECIALTIES		
General Surgery	1:12,292	1,971
Cardio/Thoracic	1:128,793	189
Neurosurgery	1:165,791	146
Obstetrics/Gynecology	1:18,074	1,341
Ophthalmology	1:30,099	805
Otolaryngology	1:51,456	471
Orthopedic Surgery	1:34,127	710
Plastic Surgery	1:107,938	224
Urology	1:56,464	429
SUBTOTAL		6,286
LABORATORY SPECIALTIES		
Nuclear Medicine	1:286,501	85
Medical Biochemistry	1:374,300	65
Medical Microbiology	1:179,896	135
Pathology	1:28,792	842
Radiology Diagnostic	1:17,449	1,389
Radiology Oncology	1:156,801	155
Medical Scientists	1:966,942	25
SUBTOTAL		2,696
ALL PHYSICIANS	1:658	36,839

Source: 'Physician Manpower in Canada 1980-2000 - A Report of the Federal/Provincial Advisory Committee on Health Manpower, July 1985.

Table 3.2: National Specialty Physician Review Ratios

	Establishment Active	Shortfall	Active Ratio #	Active + Shortfall Ratio #	Fed/Prov Recommendation' Ratio
Anaesthesia	2,145	71	11,900	11,500	13,805
Community Medicine	422	55	60,450	53,450	131,856
Diagnostic Radiology	1,572	21	16,200	16,000	17,447
Internal Medicine					
General Internal	1,179	*	21,650	*	(8,166)
Cardiology	687	108	37,100	32,100	-
Clinical Immunology and Allergy	149	33	171,150	140,100	-
Dermatology	392	15	65,050	62,650	77,098
Endocrinology and Metabolism	254	79	100,400	76,600	-
Gastroenterology	346	60	73,700	62,800	-
Geriatric Medicine	115	**	221,750	**	-
Haematology	229	37	111,350	95,850	-
Infectious Diseases	133	**	191,750	**	-
Medical Oncology	178	45	143,250	114,350	-
Nephrology	199	28	128,150	112,350	-
Neurology	373	57	68,350	59,300	89,948
Respiratory Medicine	295	18	86,450	81,450	-
Rheumatology	225	46	113,350	94,100	-
Emergency Medicine	506	**	50,400	**	-
Laboratory Medicine					28,792
Tissue Pathology	923	80	27,650	25,400	
Clinical Pathology	263	58	96,950	79,450	-
Medical Genetics	60	**	425,000	**	-
Nuclear Medicine	139	61	183,450	127,500	286,501
Obstetrics & Gynecology	1,338	***	19,050	***	18,074
Ophthalmology	860	0	29,650	29,650	30,000
Otolaryngology	528	30	48,300	45,700	51,456
Pediatrics					19,355
General	1, 021	0	25,000	25,000	-
Subspecialties	594	***	42,950	***	-
Physical Medicine	200	98	127,500	85,550	113,758
Psychiatry	3,038	***	8,400	***	10,232
Radiation Oncology	153	41	166,650	131,450	156,802
Surgery					
General Surgery	1,779	62	14,350	13,850	12,292
Cardiovascular and Thoracic Surgery	161	0	158,400	158,400	128,793
Neurosurgery	170	27	150,000	129,450	165,791
Orthopedic Surgery	810	118	31,450	27,500	34,000
Plastic Surgery	298	0	85,550	85,550	108,000
Urology	458	33	5,577	51,950	56,464
TOTAL	**22,192**	**1,281**			

Source: National Specialty Physician Review of Royal College of Physicians and Surgeons of Canada, July 1988.

Notes:

- Population per physician ratios

*Not defined, **Emerging discipline - hence shortfall unclear

*** Emerging subspecialties - hence shortfall unclear

( ) includes internal medicine and subspecialties except dermatology and neurology

POPULATION: as of December 31,1986, 25,500,800

Table 3.3: Inverted Recommended Physician-to-Population Ratios

Specialty	Physicians per 100,000 Population
GENERAL/FAMILY PRACTICE[1]	76.5
MEDICAL SPECIALTIES	
Internal Medicine[2]	19.6
Dermatology	1.6
Neurology	1.7
Pediatrics*	6.3
Physical Medicine	1.2
Psychiatry[$]	11.9
Public Health/Community Medicine[3]	1.9
Anesthesia	8.7
SURGICAL SPECIALTIES	
General Surgery	7.2
Cardio/Thoracic	0.6
Neurosurgery	0.8
Obstetrics/Gynecology[$]	5.2
Ophthalmology	3.4
Otolaryngology	2.2
Orthopedic Surgery	3.6
Plastic Surgery	1.2
Urology	1.9
LABORATORY SPECIALTIES	
Nuclear Medicine	0.8
Pathology[4]	5.1
Diagnostic Radiology	6.3
Radiation Oncology[5]	0.8
ALL PHYSICIANS[1]	152.0

Source: Tables 3.1 & 3.2

Notes:

1- Based on Federal/Provincial recommended ratio (Table 4.6), therefore ratio for all physicians is not the sum of the above ratios.

2 – General Internal, Cardiology, Clinical Immunology & Allergy, Endocrinology & Metabolism, Gastroenterology, Geriatric Medicine, Haematology, Infectious Diseases, Medical Oncology, Nephrology, Respiratory Medicine, Rheumatology, Emergency Medicine and Medical Genetics were combined under **INTERNAL MEDICINE** (a new ratio of 1:5090 was derived)

3 - **PUBLIC HEALTH/COMMUNITY MEDICINE** includes Occupational Medicine

4 – 1. Clinical Pathology – (Medical Biochemistry, Medical Microbiology, Haematological Pathology)
2. Tissue Pathology – (Laboratory Medicine, General Pathology, Anatomic Pathology, Neuropathology)
have been combined under **PATHOLOGY** (a new ratio of 1:19,260 was derived)

5- **RADIATION ONCOLOGY** includes Therapeutic Radiology

$ - Recommended ratios are based on "Active" physicians *only*. National Speciality Physician Review (RCPSC) – Table 4.7

* - General Pediatrics and its sub-specialities have been combined under **PEDIATRICS** (a new ratio of 1:15,800 was derived)

- As with the 1988 National Specialty Physician Review (RCPSC) the base year used for calculating new ratios was 1986 population -25,500,800

- Medical Scientist was omitted from list

Chapter Four

RESULTS

This chapter will present the results of the study. The focus will initially be on detecting the changes that have taken place from 1993 to 1999. The presentation will be structured along the same issues (community size, EA income, latitude north, province/territory and medical specialty) as in the Ng et al study, to allow for comparability. Also, results of a correlation analysis performed to ascertain the relationship between the proximity to physician and physician-to-population ratio approaches, will be discussed. Finally, the outcome of classifying areas as "under-served" or "well-served" and selected socio-economic characteristics of these areas will be presented. More detailed results appear in appendices C to G.

4.1 Changes in Proximity and Physician Supply, Canada, 1993 to 1999

4.1.1 Median distance to the nearest physician: The median distance to the nearest physician remained the same (0.5 km – the minimum distance assigned when EAs were the same) over the time period. Other changes were minimal - see table 4.1.

4.1.2 Physician-to-population ratio: Canada's population grew from 27,296,859 in 1991 to 28,846,761 in 1996 - an increase of about 6% - and the number of physicians declined by 0.9% (from 57,291 to

56,775) from 1993 to 1999. The physician-to-population ratio therefore decreased from 210 to 197 per 100,000 (6%) over the six years of the study.

Table 4.1: Changes in Proximity and Physician Supply, Canada, 1993 to 1999

	1993	1999	% Change from 1993
Median Distance to the Nearest Physician	0.5 km	0.5 km	No change
% of population less than 5 km to the nearest physician	86.8%	87.3%	+ 0.5%
% of population 5 -24 km to the nearest physician	11.5%	11.0%	- 4.5%
% of population 25-49 km to the nearest physician	1.2%	1.2%	No change
% of population 50-99 km to the nearest physician	0.3%	0.3%	No change
% of population 100-149 km to the nearest physician	0.1%	0.1%	No change
Population	27,296,859*	28,846,761**	+ 5.7%
Number of Physicians	57,291	56,775	- 0.9%
Physician-to-Population Ratio	210	197	- 6.2

Notes:
(*) refers to 1991 population
(**) refers to 1996 population

4.2 Factors that Influence Travel Distance and Physician Supply

4.2.1 Province or Territory

(i) Province

Provincial differences in the percentage of the population living less than 5 km from the nearest physician persist. As in 1993, over 90% of the population of British Columbia, Quebec and Ontario lived less than 5 km from a physician (see table 4.2). In Nova Scotia and New Brunswick the percentage of the population less than 5 km from a doctor increased by 6% and 7% respectively. By contrast, Prince Edward Island experienced a 6% percent drop from 64% in 1993 to 61% in 1999 in the percentage of the population living within 5 km from a doctor. There were minor changes in the remaining provinces (see table 4.2 or appendix C).

The general pattern with regards to the physician-to-population ratios barely changed; the more urbanized a province the higher the ratio (implying greater availability of physicians). Table 4.3 highlights this state of affairs. With the exception of New Brunswick, where the physician-to-population ratio increased from 151 in 1993 to 161 in 1999, all the other provinces experienced a decrease in their physician-to-population ratios. Newfoundland emerged as the province with the most dramatic decrease (18%) compared to 1993. Likewise, British Columbia witnessed a (14%) decrease in its physician-to-population ratios, and Nova Scotia almost as great a decrease (11%). On other hand, Saskatchewan's ratio remained unchanged (see table 4.3).

(ii) Territory

The median distance to the nearest physician in the Yukon increased marginally from 2.1 to 2.5 km, but in the Northwest Territories (including Nunavut) the distance doubled from 1.2 to 2.4 km during the same time period. The proportion of the population less than 5 km from a physician dropped in both regions: from 68% to 55% in the Yukon and 57% to 52% in the Northwest Territories (see appendix C). Furthermore, the percentage of the population in the Northwest Territories who had to travel 150 km or more to a physician rose from 31% in 1993 to 37% in 1999.

The physician-to-population ratio in both the Yukon and Northwest Territories increased from 1993 to 1999. The ratio increased by 6% from 144 in 1993 to 153 in 1999 in the Yukon. In the Northwest Territories the ratio was 94 in 1993 and 101 in 1999 - an increase of 7%.

Table 4.2: Percentage of Population less than 5 km from a Physician, by Province

Province	1993	1999*	% Change from 1993
British Columbia	91.2	92.6	+1.5
Ontario	90.7	91.1	+0.4
Quebec	91.2	90.2	-1.0
Canada	**86.8**	**87.3**	**+0.5**
Alberta	82.9	82.7	-0.2
Manitoba	78.4	78.9	+0.6
Nova Scotia	69.6	73.5	+5.6
Newfoundland	72.4	72.5	+0.1
Saskatchewan	67.9	68.6	+1.0
New Brunswick	62.8	66.9	+6.5
Prince Edward Island	64.3	60.5	-5.9

* Provinces displayed by 1999 results

Table 4.3: Physicians per 100,000 Population, by Province

Province	1993	1999*	% Change from 1993
Québec	224	215	-4.0
British Columbia	248	214	-13.7
Nova Scotia	228	204	-10.5
Canada	**210**	**197**	**-6.2**
Ontario	206	194	-5.8
Manitoba	205	187	-8.7
Alberta	182	177	-2.7
Newfoundland	200	164	-18.0
New Brunswick	151	161	+6.6
Saskatchewan	156	156	No change
Prince Edward Island	139	135	-2.8

* Provinces displayed by 1999 results

4.2.2 Community Size

(i) CMA/CA areas (Big Cities or Urban Centres)

Canadians living in large urban centres are generally not far from a doctor. As in 1993, at least 90% of the residents in almost all of Canada's 25 CMAs resided less than 5 km away from the nearest doctor. The proportion of CMA population living less than 5 km from the nearest doctor increased in all CMAs except in Ottawa-Hull, Edmonton, Winnipeg and London (see appendix D), although marginally. There was no change in the percentage of residents living in CMAs with at least one million inhabitants (Toronto, Montreal and Vancouver in 1991; also Ottawa-Hull in 1996) living less than 5 km from the nearest physician. Almost the entire population in big cities (99%) still live less than 5 km away from a physician.

In 1993, Canada's three largest CMAs, Toronto, Montreal and Vancouver, had 32% of the population, but 39% of the country's doctors. The CMA of Ottawa-Hull joined the list of urban centres with more than one million inhabitants in 1996. With this addition Canada's four largest CMAs in 1999 had 36% of the country's population and 44% of its physicians.

The average physician-to-population ratio in Canada's 25 CMAs decreased by 8% from 1993 to 1999 (see table 4.4, and figure 4.1 or appendix D). The CMAs with above average CMA physician-to-population ratios all experienced declines in physician supply. All but four of the CMAs with low physician-to-population ratios (below average CMA) in 1993 witnessed a decrease in their ratios (see table 4.4), implying further reduced

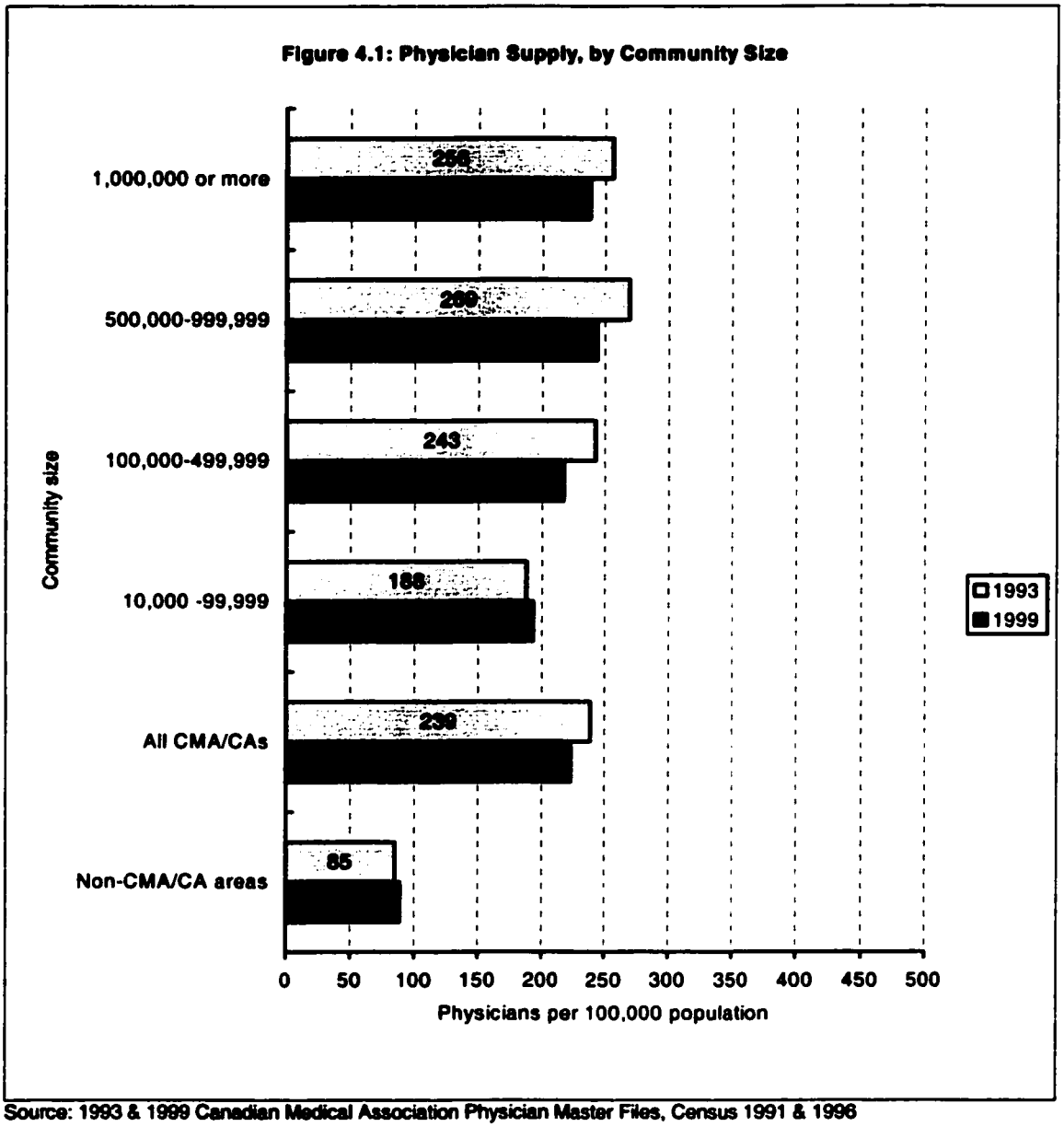
availability of physicians to the population, although the decreases were relatively small.

Table 4.4: Physicians per 100,000 Population in Canada's, 25 CMAs

CMA	1993	1999*	% Change from 1993
Sherbrooke	470	374	-20.4
Halifax	390	327	-16.1
Québec City	356	318	-10.7
London	342	309	-9.6
Victoria	350	282	-19.4
Saskatoon	296	280	-5.4
Ottawa-Hull	294	273	-7.1
St. John's	338	268	-20.7
Vancouver	295	251	-14.9
Montreal	264	243	-7.9
Winnipeg	271	243	-10.3
Hamilton	255	238	-6.6
All 25 CMAs	**257**	**236**	**-8.1**
Toronto	235	221	-5.9
Edmonton	228	220	-3.5
Calgary	219	216	-1.3
Saint John	218	212	-2.8
Regina	214	206	-3.7
Trois-Rivières	199	204	+2.5
Chicoutimi-Jonquière	181	186	+2.8
Sudbury	170	176	+3.5
Thunder Bay	175	162	-7.4
Windsor	151	147	-2.6
Kitchener	148	137	-7.4
Oshawa	128	132	+3.1
St. Catharines-Niagara	136	127	-6.6

*CMAs displayed by 1999 results

Note: see map in appendix I for the location of these cities.



Source: 1993 & 1999 Canadian Medical Association Physician Master Files, Census 1991 & 1996

(ii) Non-CMA/CA areas (Outside Urban Centres)

As noted by Ng et al, the smaller the community the greater the distance one must travel to the nearest physician (10, 15). This general pattern has not changed. The percentage of the population in non-CMA/CA areas who live

less than 5 km from a physician declined by a percentage point from 56% in 1993 to 55% in 1999.

In 1993, non-CMA/CA areas encompassed 23% of Canada's population but had only 9% of the country's physicians. The non-CMA/CA proportion of the country's population shrank slightly to 22% and its share of physicians rose marginally to 10% in 1999. The physician-to-population ratio accordingly rose by 4% (see figure 4.1 or appendix D).

4.2.3 Average EA income

As mentioned in chapter three (section 3.3), EAs were classified into two broad groups for the purpose of exploring the effect of average income: "more urbanized" or "less urbanized and rural". EAs in both groups were ranked separately by income and classified into five "area-based" income quintiles. Lowest and highest quintiles were defined under Income Per Person Equivalent (IPPE) – see Definitions.

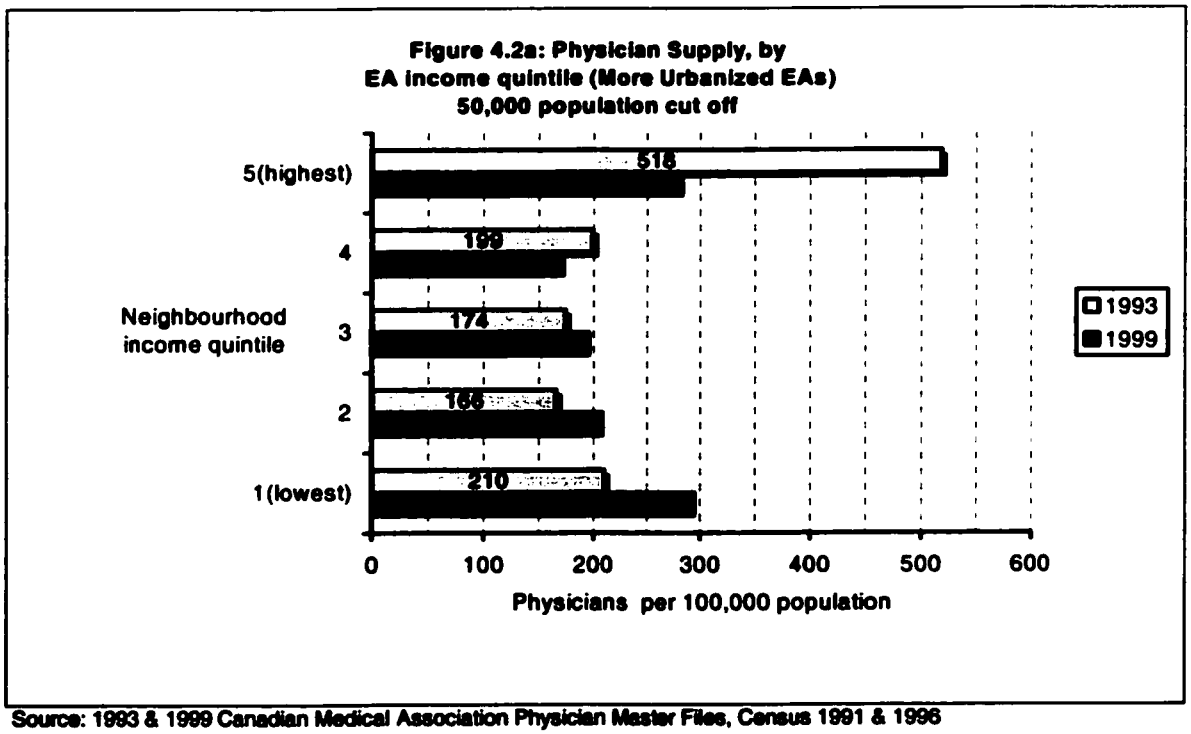
(1a) More Urbanized EAs (population above 50,000)

As in 1993, EA income had little or no effect on the relationship between distance and the nearest physician in the more urbanized EAs of the country. In 1999, 99% of residents in the lowest EA income quintile and 98% of residents in the highest EA income quintile lived within 5 km from the nearest physician (see table 4.5a or appendix E). In 1993, both figures were 98%. The fourth and fifth income quintiles (highest) witnessed a decrease in

physician-to-population ratio. The decline was very sharp in the highest income quintile - a 45% reduction in six years (see figure 4.2a). In the lowest income quintile, the physician-to-population ratio increased by 40% in six years. The ratio also surged in the second income quintile by 25% (see figure 4.2a).

Table 4.5a: Percentage of Population less than 5 km from a Physician by Income Quintile 1999 and 1993
(50,000 population cut off)

	Income Quintile				
	1(lowest)	2	3	4	5(highest)
More Urbanized					
1999	99	97	96	97	98
1993	98	97	96	96	98
Less Urbanized & Rural					
1999	58	63	66	70	75
1993	55	64	69	73	76

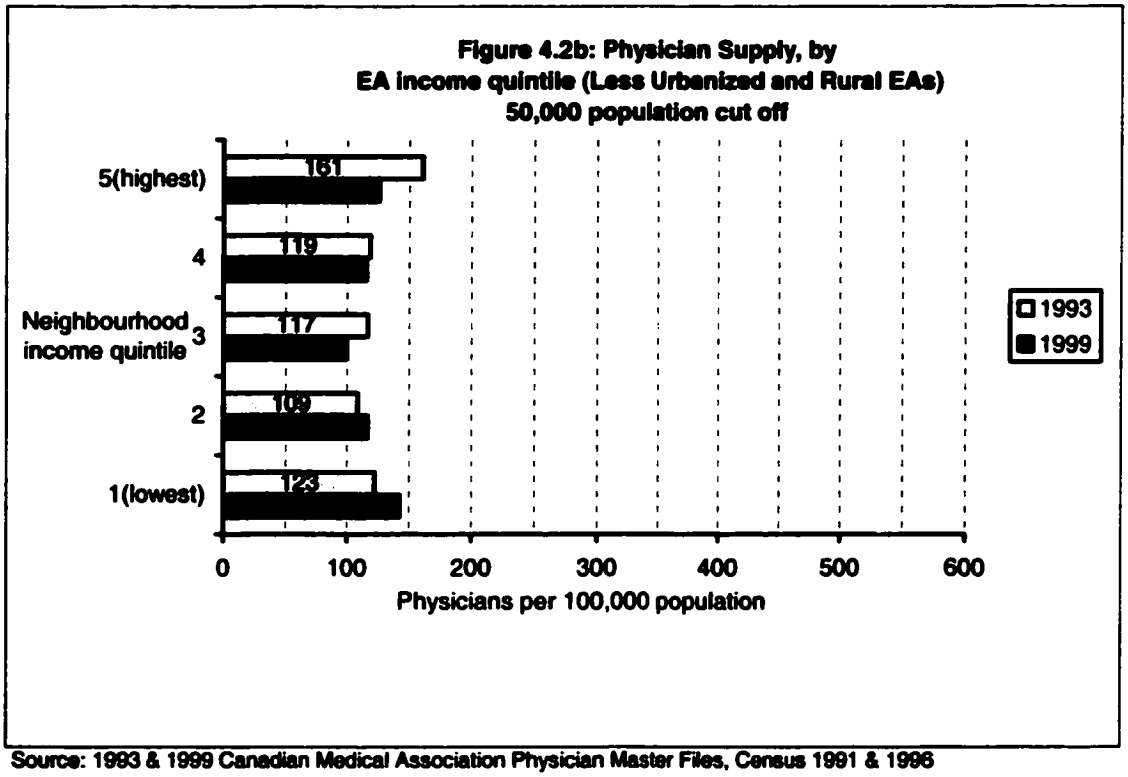


Source: 1993 & 1999 Canadian Medical Association Physician Master Files, Census 1991 & 1996

(1b) Less Urbanized and Rural EAs (population below 50,000)

In contrast to the more urbanized EAs, distance traveled to the nearest physician was much greater in less urbanized and rural EAs. The general pattern showed longer distances as income quintile dropped, with a similar pattern in 1993 and 1999 (see table 4.5a or appendix E).

The physician-to-population ratio increased by 16% in the first (lowest) and by 8% in the second quintile (see figure 4.2b). The other income quintiles experienced a drop in their physician-to population.



Source: 1993 & 1999 Canadian Medical Association Physician Master Files, Census 1991 & 1996

(2) Reclassified "More Urbanized" and "Less Urbanized/ Rural" EAs

A reclassification of "more urbanized" and "less urbanized/ rural" EAs was done to ascertain whether the impact of EA income on distance traveled to the nearest physician had been concealed by the choice of cut-off point. The reclassification was done for both 1993 (Ng et al. study) and the present study using a yardstick of 10,000 inhabitants (see Definitions). The results of this re-categorization (table 4.5b, appendix F, figures 4.3a and 4.3b) were similar to those using the 50,000 population cut-off.

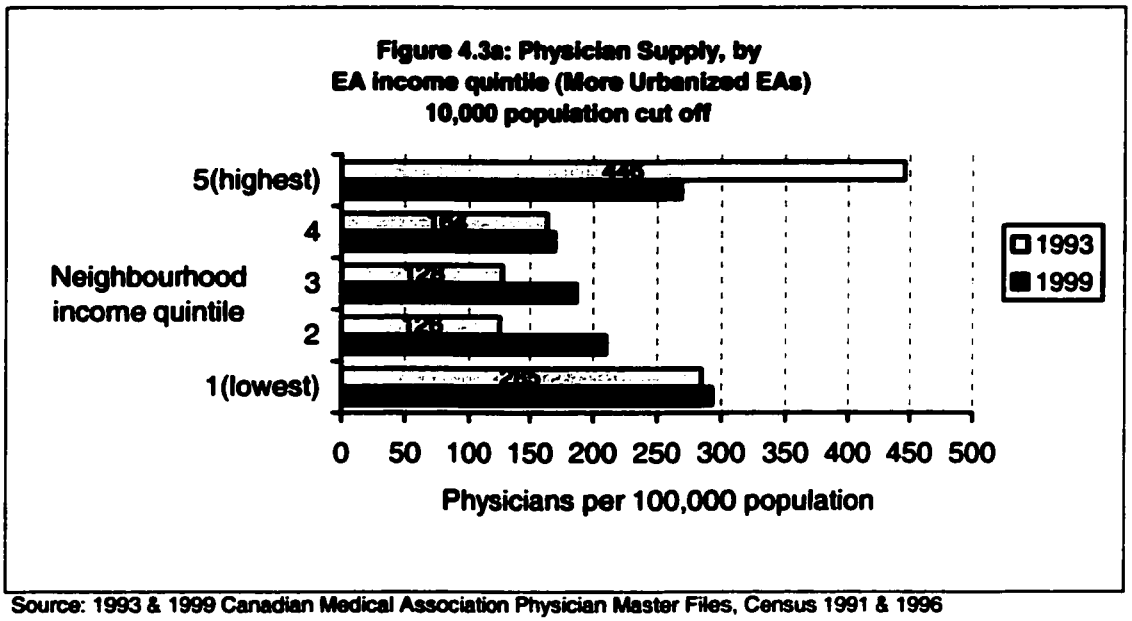
Table 4.5b: Percentage of Population less than 5 km from a Physician by Income Quintile 1999 and 1993
(10,000 population cut off)

	Income Quintile				
	1(lowest)	2	3	4	5(highest)
More Urbanized					
1999	98	96	95	96	98
1993	97	95	95	96	97
Less Urbanized & Rural					
1999	42	52	56	60	67
1993	36	52	59	63	69

(2a) More Urbanized EAs (population above 10,000)

In 1993, 97% of the people living in the lowest EA income quintile (with 25% of the physician workforce) traveled less than 5 km to the nearest doctor (see table 4.5b). The same was the case for those in the highest income quintile, although they had 38% of physician population in their neighbourhood. By 1999 and despite differences in the percentages of physicians in the lowest

(26%) and highest (23%) income quintiles, 98% of the population residing in both income quintiles were less than 5 km from a physician (see table 4.5b). The physician-to-population ratio in the highest income quintile decreased substantially from 446 in 1993 to 269 in 1999, a decline of 40% in six years (see figure 4.3a or appendix F).



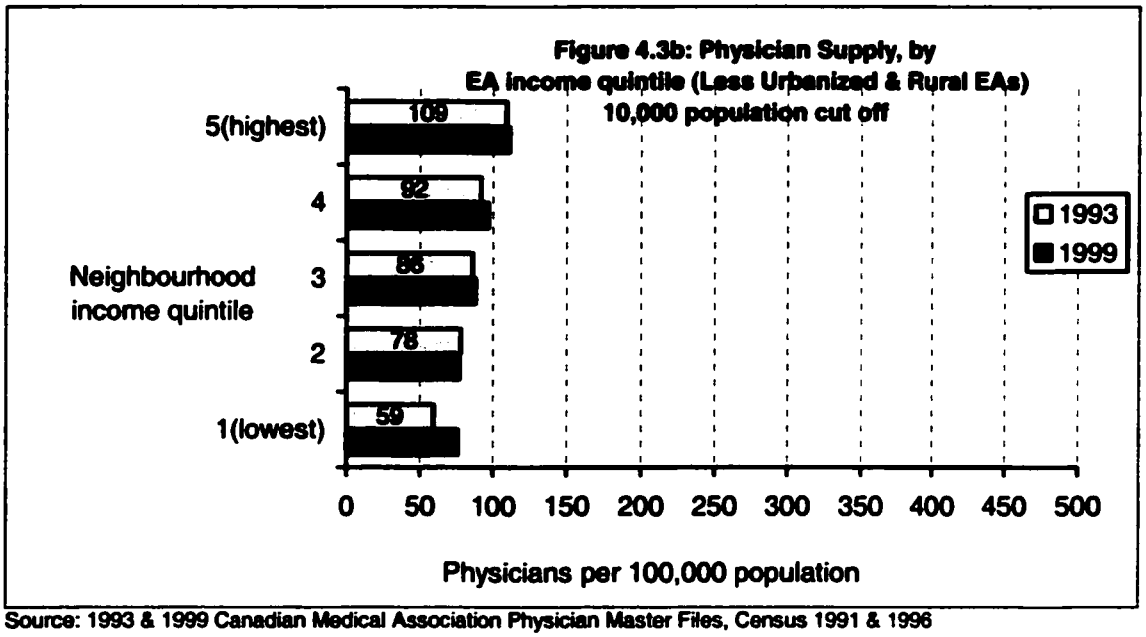
Source: 1993 & 1999 Canadian Medical Association Physician Master Files, Census 1991 & 1996

(2b) Less Urbanized and Rural EAs (population below 10,000)

EA income quintile level varied with distance to the nearest physician in the less urbanized and rural EAs. The percentage of the population less than 5 km from a physician in the highest income quintile was much greater than in the lowest income quintile. In 1999, 42% of the population in the lowest EA income quintile while 67% of those in the highest income quintile were less than 5 km from a physician. In 1993, the percentage of the population in the lowest EA income quintile less than 5 km from a physician was 36%

compared to 69% in the highest income quintile (see table 4.5b).

With the exception the second income quintile the physician-to-population ratio increased in all income quintiles. The most recognizable increase was in the lowest income quintile from 59 in 1993 to 76 in 1999, an increase of 29% in six years (see figure 4.3b or appendix F).



Source: 1993 & 1999 Canadian Medical Association Physician Master Files, Census 1991 & 1996

4.2.4 Latitude North

As shown in figure 4.4, the percentage of the population living 100 km or more from a physician at latitudes 70°+ remains at 100 percent as in 1993. This is expected since, as with Ng's 1997 study, there were no permanent physicians[6] at latitudes 70°+ north in 1999 to serve the 3,900 residents living in that region.

[6] Physician services may be available on temporary or on rotational assignments in remote areas. Additionally, other forms of medical services may be available through clinics staffed

At latitudes 65-<70° and 60 - <65° north the percentages increased slightly from 1993 to 1999, while there was little change further south (see appendix E). In contrast, the region encompassing latitude 45-<50° north, which includes Montreal, Ottawa and Vancouver has 88% of its residents living less than 5 km from a physician.

Although the physician-to-population ratio at latitude 65-<70° north increased by 60%, from 25 in 1993 to 40 in 1999, it was still far lower than at lower latitudes (see figure 4.5 or appendix E).

In general, distance to the nearest physician tends to be shorter at lower latitudes than at high latitudes, and physician-to-population ratios are low at high latitudes. A visual representation of latitudes in Canada is provided in figure 4.6.

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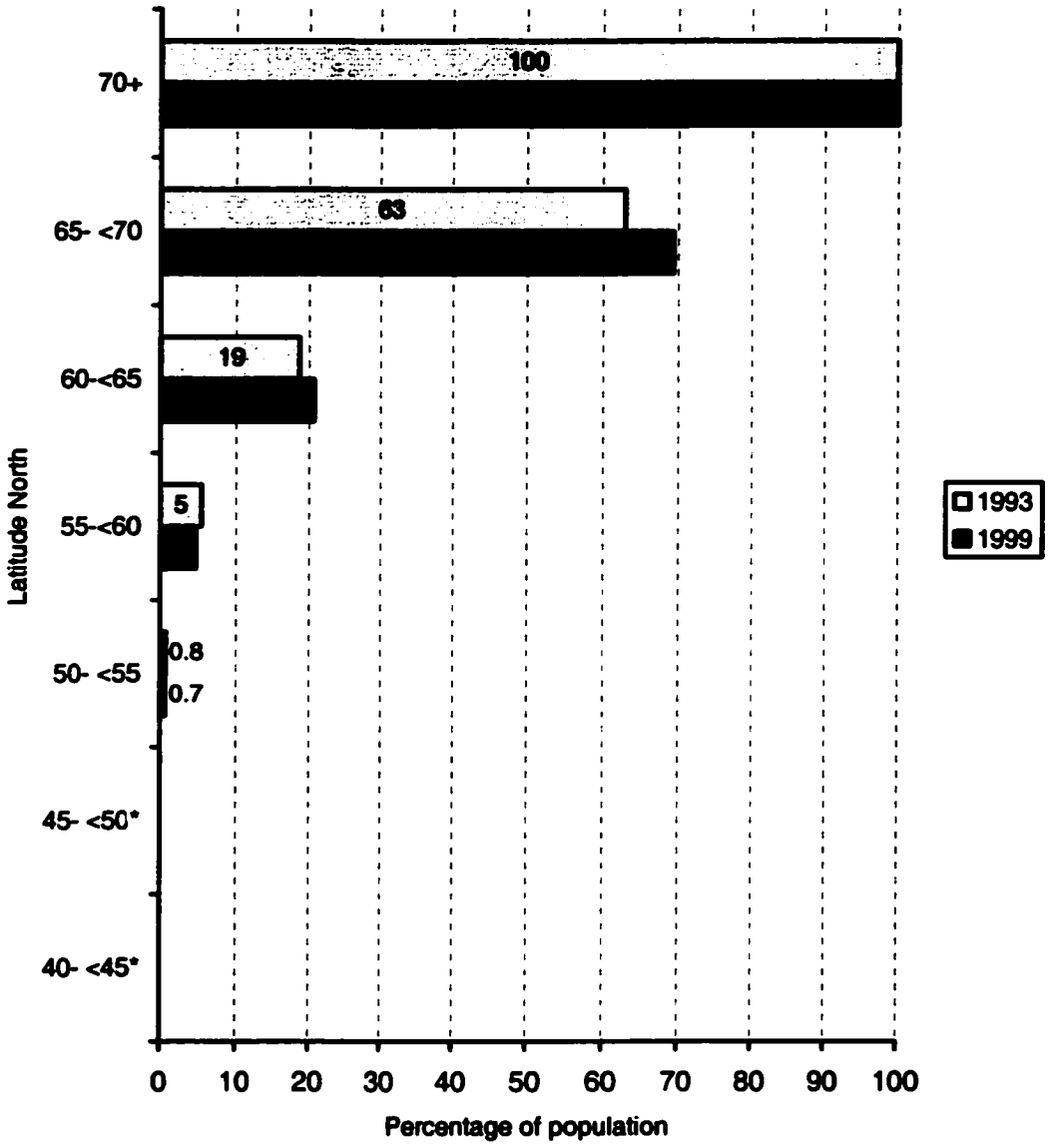
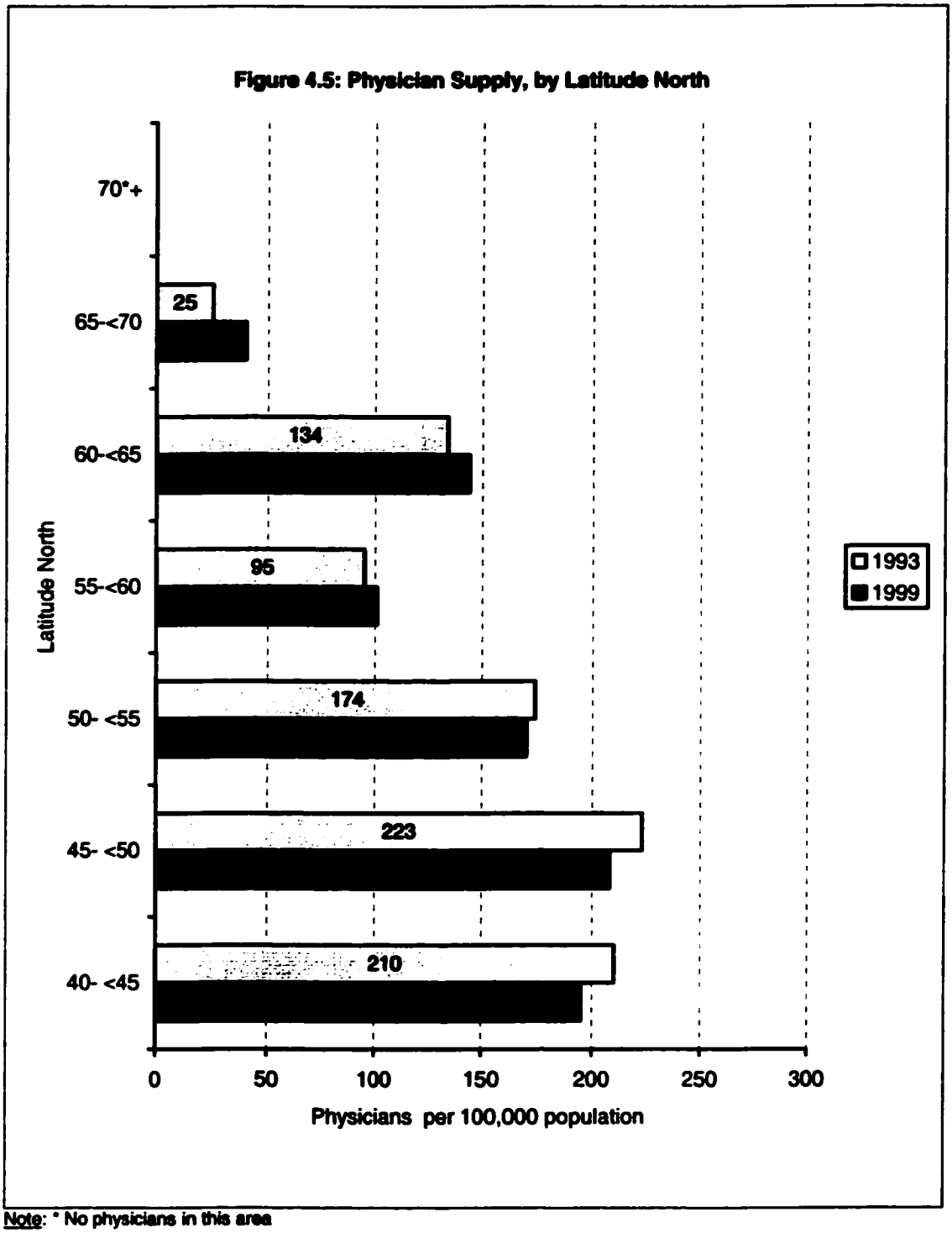
by nurses. The First Nations and Inuit Health Branch of Health Canada provide these services.

Figure 4.4: Percentage of Population 100 km or more from a Physician, by Latitude North



Note: * Percentage is zero below <50 N

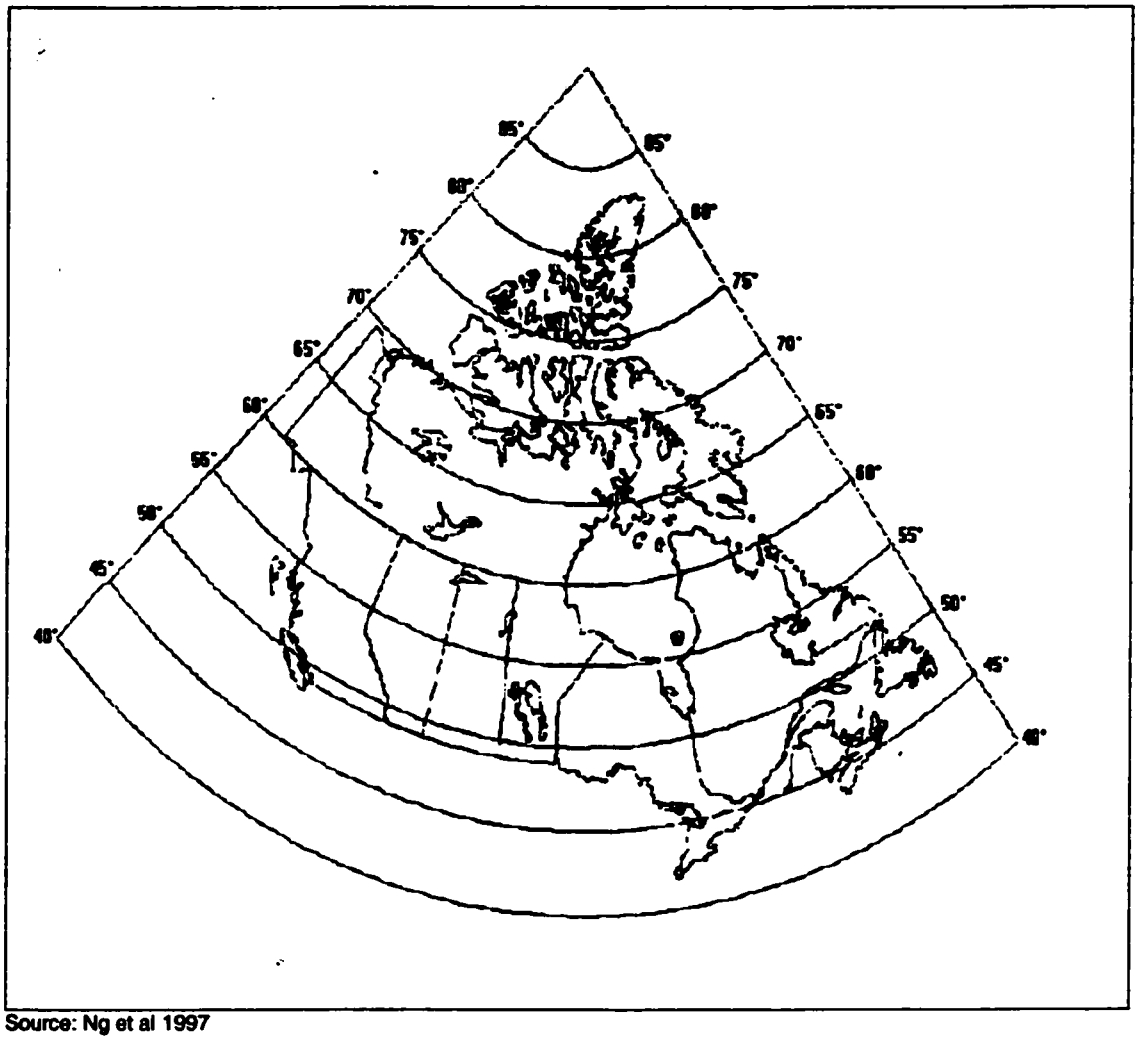
Source: 1993 & 1999 Canadian Medical Association Physician Master Files, Census 1991 & 1996



Note: * No physicians in this area

Source: 1993 & 1999 Canadian Medical Association Physician Master Files, Census 1991 & 1996

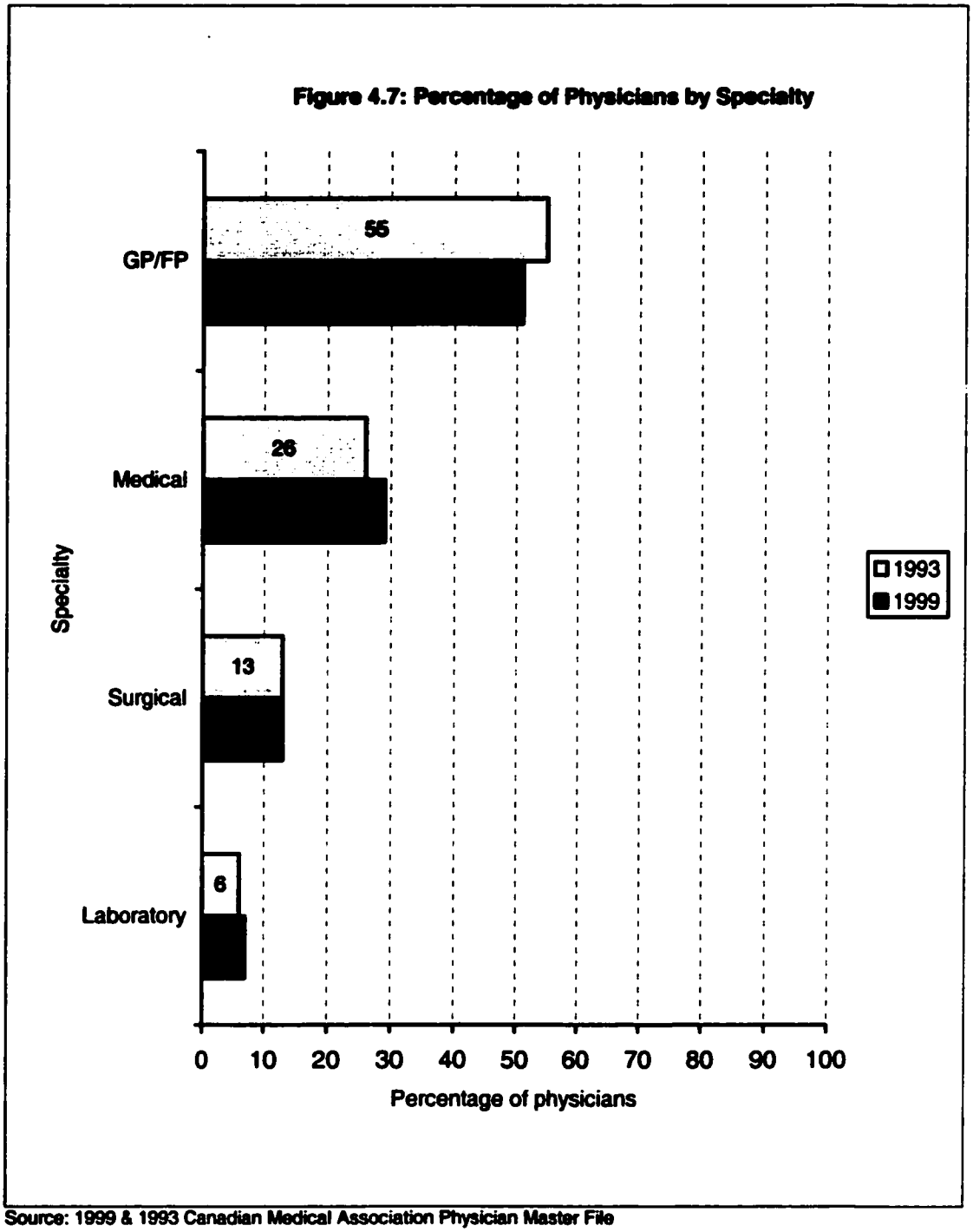
Figure 4.6: Map of Canada with Degrees of Latitude



Source: Ng et al 1997

4.2.5 Medical Specialty

General practitioners or family physicians are the first point of contact between Canadians and their health care system. In 1999, 51% of Canada's physician population were generalists compared to 55% in 1993 (see figure 4.7). The percentage of the population within 5 km of a general practitioner decreased from 86% in 1993 to 83% in 1999. Detailed results on distance traveled to the nearest specialist are provided in appendix G.



Source: 1999 & 1993 Canadian Medical Association Physician Master File

No clear trends were observed from 1993 to 1999 in the mean and median distances traveled to access the services of specialists. In some specialties

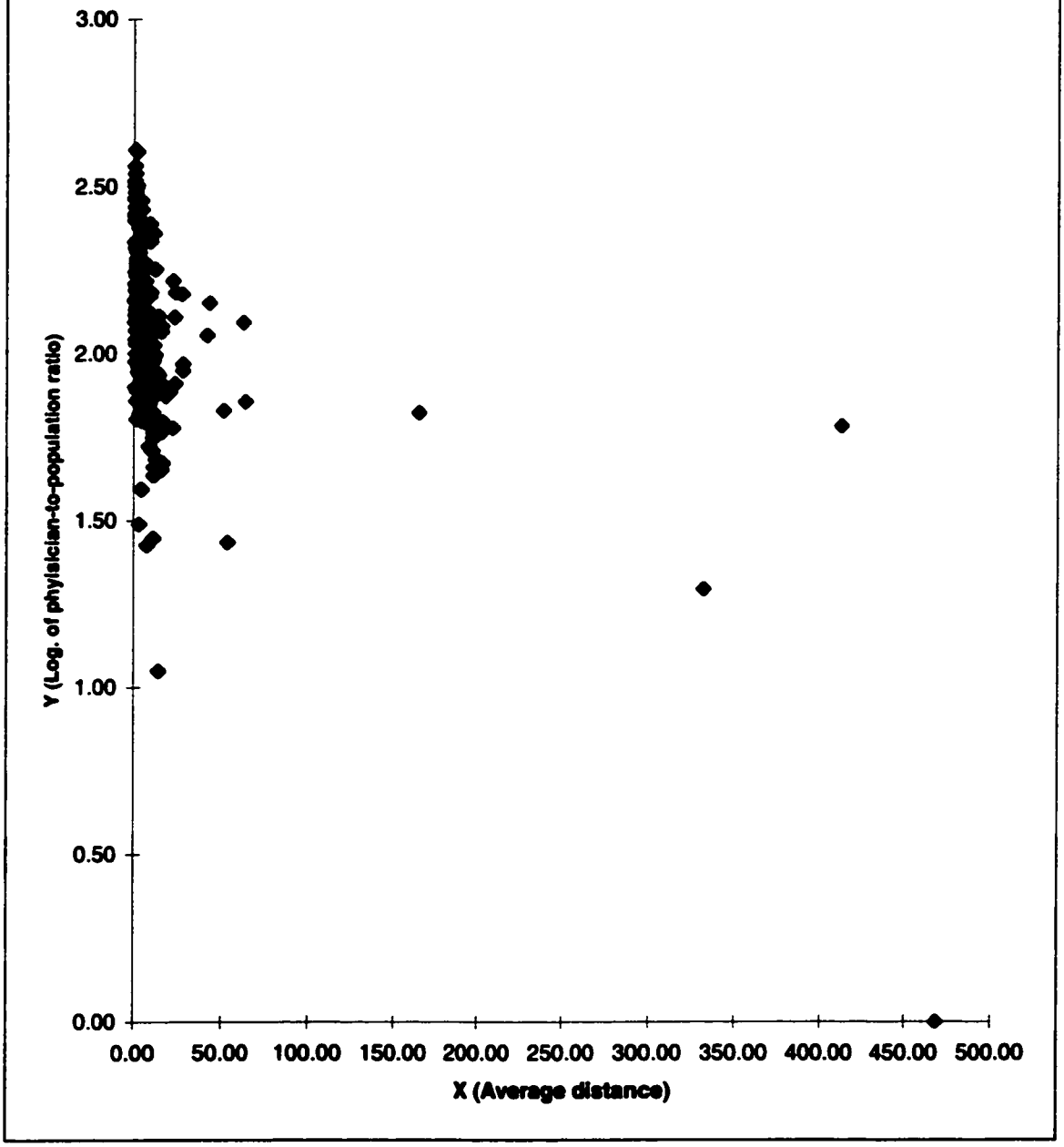
the distance increased while in others it decreased. For instance the mean and median distance to a cardiovascular/thoracic surgeon decreased from 63 to 56 km and 13 to 11 km respectively (the number of physicians went up due to the addition of thoracic surgery and cardio-thoracic surgery to this category) -(see [notes under] appendix G for entire list). In general, the larger the number of physicians in a specialty group, the shorter the distance traveled. The median distance traveled to see a psychiatrist, an anaesthesiologist or an obstetrician/gynecologist increased from 2.2 to 2.6 km, 2.4 to 3.0 km and 2.8 to 3.4 km respectively. On the other hand, both mean and median distance to a dermatologist, emergency medicine specialist or endocrinologist decreased from 5.3 to 4.8 km, 6.8 to 4.6 km and 13.4 to 9.3 km respectively during the same period (see [notes under] appendix G for entire list).

4.3 The Relationship between Physician Proximity and Physician-to-Population Ratio

Do proximity and supply convey the same information? A correlation analysis was done on the average distance and physician-to population ratios at the CD level to ascertain the relationship between the two approaches. A logarithmic transformation of the physician-to-population ratio was used to assess this relationship in order to render the relationship more linear. Figure 4.8 below displays the scatter plot of these two variables. A correlation coefficient of -0.49 was derived from this analysis, which implies that the

physician-to-population ratio is negatively correlated to average distance. Thus the more physicians in a CD, the shorter the average travel distance.

Figure 4.8: Distance versus Ratio Scatter Plot



4.4 "Under-Served" and "Well-Served" Areas

4.4.1 Classifying Areas as "Under-Served" or "Well-Served"

Table 3.3 (derived from tables 3.1 and 3.2 - see Methods) was used as a guide to calculate the percentage of CDs with the recommended physician-to-population ratio for each specialty. The result of this computation is depicted in table 4.6a. A quick look at table 4.6a reveals that a greater percentage of rural CDs are "under-served". This is apparent in all categories of physician specialties and for all specialties combined (any/all physician): 49% of all urban CDs are "well-served" compared to 18% of all rural CDs when all physicians are considered. The most striking disparity between urban and rural CDs is evident in the GP/FP percentages of recommended physician-to-population. Only 9% of rural CDs (16/177) have the required GP/FP physician ratio compared to 72% of the urban CDs (80/111).

It needs to be clarified that not all CDs have physicians located in them (see table 4.6b), for instance there are only 34 CDs with practicing Neurosurgeons, out of 288 CDs in Canada. Thus only 11% of all CDs (urban and rural) have Neurosurgery care available locally. Furthermore, it should be reiterated that 33 of the 34 CDs with practicing Neurosurgeons are urban. Thus only 1 Neurosurgery practice is located in a rural CD. In general, it can be concluded that a relatively small percentage of the population living in rural CDs have specialist services readily available to them.

Lastly, as depicted by table 4.6b, one CD located in the Northwest Territory did not have any record of physicians. The CD, which encompasses

the Keewatin region, was rural and had 6868 inhabitants in 1996.

Table 4.6a: Percentage and Number of CDs with at least Recommended Physician-to-Population Ratios
(50,000 population cut off)

Specialty	Urban (U)		Rural (R)		Total	
	111	(39%)	177	(61%)	288	(100%)
GENERAL/FAMILY PRACTICE	80	72%	16	9%	96	33%
MEDICAL SPECIALTIES						
Neurology	37	33%	10	6%	47	16%
Dermatology	38	34%	8	5%	46	16%
Pediatrics	33	30%	11	6%	44	15%
Anaesthesia	34	31%	6	3%	40	14%
Public Health/Community Medicine	17	15%	21	12%	38	13%
Psychiatry	29	26%	8	5%	37	13%
Internal Medicine	28	25%	6	3%	34	12%
Physical Medicine	28	25%	2	1%	30	10%
SURGICAL SPECIALTIES						
Urology	56	50%	18	10%	74	25%
General Surgery	30	27%	43	24%	73	25%
Orthopedic Surgery	53	48%	16	9%	69	24%
Ophthalmology	48	43%	19	11%	67	23%
Otolaryngology	38	34%	23	13%	61	21%
Obstetrics/Gynecology	45	41%	14	8%	59	20%
Plastic Surgery	46	41%	8	5%	54	19%
Cardio/Thoracic	35	32%	3	2%	38	13%
Neurosurgery	29	26%	1	1%	30	10%
LABORATORY SPECIALTIES						
Radiology Diagnostic	44	40%	17	10%	61	21%
Nuclear Medicine	39	35%	10	6%	49	17%
Pathology	30	27%	6	3%	36	13%
Radiology Oncology	29	26%	2	1%	31	10%
ALL/ANY PHYSICIAN	54	49%	31	18%	85	30%

Notes:
Percentages derived by dividing number of CDs with at least recommended physician supply by total number of CDs e.g. (urban: 80/111*100)

Table 4.6b: Number and Percentage of CDs with Any Physician
(50,000 population cut off)

Specialty	Urban	(U)(%)	Rural	(R) (%)	Total	(%)
	111	39%	177	61%	288	100%
GENERAL/FAMILY PRACTICE	111	100%	175	96%	286	99%
MEDICAL SPECIALTIES						
Internal Medicine	109	98%	80	45%	189	66%
Psychiatry	104	94%	63	36%	167	58%
Pediatrics	98	88%	46	26%	144	50%
Anaesthesia	94	85%	47	27%	141	49%
Dermatology	74	67%	8	5%	82	28%
Public Health/Community Medicine	57	51%	21	12%	78	27%
Neurology	59	53%	10	6%	69	23%
Physical Medicine	52	47%	2	1%	54	18%
SURGICAL SPECIALTIES						
General Surgery	110	99%	93	53%	203	70%
Obstetrics/Gynecology	97	87%	44	25%	141	49%
Ophthalmology	92	83%	32	18%	124	43%
Orthopedic Surgery	92	83%	28	16%	120	42%
Urology	89	80%	18	10%	107	37%
Otolaryngology	82	74%	23	13%	105	36%
Plastic Surgery	59	53%	10	6%	69	23%
Cardio/Thoracic	42	38%	3	2%	45	16%
Neurosurgery	33	30%	1	0.5%	34	11%
LABORATORY SPECIALTIES						
Radiology Diagnostic	104	94%	60	34%	164	57%
Pathology	95	86%	33	19%	128	44%
Nuclear Medicine	51	46%	10	6%	61	21%
Radiology Oncology	36	32%	2	1%	38	13%
ALL/ANY PHYSICIAN	111	100%	176	99%	287[$]	99%

Notes:
$ - 1 CD in the Northwest Territories does not have any resident physician
- Percentages derived by dividing number of CDs with any physician by the total number of CDs e.g. (286/288*100)

4.4.2 Socio-Economic Characteristics of "Under-Served" and "Well-Served" CDs

Based on the rural-urban classification described in section 3.4 and in the preceding section CDs with the highest physician-to-population ratio were categorized as "best-served" and vice versa where the reverse was the case.

The ten "best-served" CDs and ten "worst-served" CDs in both urban and rural strata were selected for comparison. This was done to examine the socio-economic or other factors associated with physician supply within urban and rural strata.

After CDs had been selected six socio-economic characteristics as portrayed in table 4.7a and 4.7b were chosen to provide a basic profile and where possible highlight differences between "well-served" and "under-served" areas. Maps on the location of these CDs have been provided in appendix I.

Urban CDs

Differences appear to exist between the "best-served" and "worst-served" CDs. A glance at table 4.7a reveals that over half of the "best-served" CDs are located in Quebec. On the other hand the "worst-served" CDs are more dispersed across the country, encompassing New Brunswick, Quebec, Ontario and Alberta.

The increase in population from 1991 to 1996 was twice as great in the "worst-served" CDs as in the "best-served" CDs. Average family income was also slightly higher in the "worst-served" CDs.

The other differences were all in the expected direction. Population density in the "best-served" CDs was about three times greater than that in the "worst-served" CDs. Less than 1% of the population in the "best-served" CDs were Aboriginal compared to over 2% in the "worst-served" CDs, although much of the difference was explained by a single Alberta CD. Furthermore, age standardized mortality (ASMR) and infant mortality rates (IMR) were lower in the "best-served" CDs than in the "worst-served" CDs, though the differences were not great. Total fertility rate (TFR) in the "worst-served" CDs was about double that in the "best-served" CDs.

Table 4.7a: Selected Characteristics of "Best-Served and "Worst-Served" Census Divisions (CD) (Urban Areas)

"Best-Served Urban CDs"	A	B	C	D	E	F	G	H	I
2424 Desjardins[1] (Lévis, QC)	347.5	51,222	4	201.8	0.0	49,246	654.3	1.37	3.8
2461 Joliette[2] (Sorel, QC)	314.1	52,845	4	126.5	0.4	45,414	770.9	1.62	5.8
2410 Rimouski-Neigette[3] (QC)	292.3	52,677	3	20.5	0.4	49,208	652.2	1.43	8.8
1301 Saint John Co. (NB)	286.2	79,302	-3	50.9	0.6	43,483	774.5	1.57	4.1
5917 Capital RD (Victoria/Esquimault, BC)	276.1	317,989	6	137.2	2.1	59,158	602.3	1.34	4.7
1307 Westmorland Co. (Moncton, NB)	236.1	120,531	5	32.4	0.3	47,793	637.8	1.36	5.0
2475 La Rivière-du-Nord[4] (St.Jérome, QC)	220.8	83,773	14	185.3	0.4	44,058	795.9	1.76	7.3
2458 Champlain[5] (Longueuil, QC)	216.7	314,306	1	1930.0	0.2	54,868	669.2	1.44	4.0
1310 York Co. (Fredericton, NB)	214.7	85,719	4	9.4	2.1	52,363	681.1	1.49	2.8
2437 Francheville (Trois Rivière, QC)	209.2	140,541	2	124.6	0.4	46,689	671.0	1.54	5.3
Weighted Averages (except column B)	**248.8**	**129,890****	**3.82**	**546.7**	**0.87**	**51,983**	**668.3**	**1.45**	**4.8**
" Worst-Served Urban CDs"									
3532 Oxford[6] Co. (Woodstock, ON)	88.5	97,142	5	16.2	0.5	55,320	690.2	1.85	6.5
4812 Division no. 12 (St. Paul, AB)[7]	88.5	56,499	4	1.8	18.2	46,910	861.4	2.41	8.0
3514 Northumberland Co. (Coburg, ON)	86.8	81,792	5	38.8	1.4	53,144	689.6	1.49	6.2
3541 Bruce Co. (Bruce Peninsula, ON)	80.7	65,680	1	16.2	1.8	52,943	808.1	1.88	6.6
2473 Thérèse-De Blainville[8] (QC)	79.7	119,240	14	583.3	0.2	57,925	678.9	1.84	3.4
2471 Vaudreuil-Soulanges[9] (Hudson, QC)	77.6	95,318	13	111.9	0.3	56,856	648.9	1.82	5.4
1305 Kings[10] Co. (Hampton/Sussex, NB)	77.3	64,724	4	18.2	0.2	54,181	654.3	1.68	4.5
4813 Division no. 13 (Athabasca, AB)[11]	75.1	62,569	8	2.6	6.2	48,903	766.9	2.05	5.8
3528 Haldimand-Norfolk RM (Simcoe, ON)	72.1	102,575	4	35.2	1.3	53,766	759.8	1.60	8.0
2464 Les Moulins[12] (Terrebonne, QC)	63.9	103,213	13	391.5	0.3	51,036	707.6	1.76	5.1
Weighted Averages (except column B)	**78.5**	**84,875****	**7.78**	**158.5**	**2.27**	**53,636**	**717.9**	**1.81**	**5.8**

Source: Columns B, C, D, E & F are based on Profile Series Data of 1996 Census; Columns F, G, H & I is from Table 8.1 of the Vital Statistics Compendium, 1996, Statistics Canada, Catalogue 84-214-XPE

Notes on Table 4.7a:

- "Best-served" refers to CDs with the highest ratio of physicians and vice versa for "Worst-served".

Column A depicts Physician-to-Population Ratios
Column B portrays 1996 Population of CDs
Column C depicts the Percentage Change in Population 1991-1996
Column D portrays Population Density of CD (population per square kilometre)
Column E portrays Percentage of Aboriginal Population
Column F refers to Average Family Income
Column G refers to Age Standardized Mortality Rate
Column H refers to Total Fertility Rate
Column I refers to Infant Mortality Rate

- According to the Vital Statistics Compendium 1996, rates in columns G, H & I were derived based on 3-year averages in the numerator and the 1995 population estimate in the denominator. This was done to prevent year-to-year fluctuations in CDs with small populations (see source for further discussion).
- % Aboriginal population was derived by dividing Aboriginal population in CD by population of CD e.g. 1301 Saint John County (NB) 550/79,302*100.
- Average family income was derived from the ALL CENSUS FAMILIES 20% sample data
- ASMR refers to the number of deaths per 100, 000 population – the above rates are for both male & female
- TFR refers to the average number of live births a woman can be expected to have in her lifetime.
- IMR refers to the number of infant deaths per 1,000 live births.

** - unweighted average
1 – East of Québec City
2 – West of Sorel in the Lanaudière Region of Québec
3 – North of La Rivière-du-Loup in the Bas-Saint-Laurent Region of Québec
4 – North of Mirabel/Lachute Area in the Laurentians Region of Québec
5 – East of Montreal
6 – West of Hamilton
7 – East of Edmonton
8 – Sainte Thérèse in the Laurentians Region of Québec
9 – West of Montreal
10 – North of Saint John (New Brunswick)
11 – North of Edmonton
12 – North of Laval in the Lanaudière Region of Québec

Co. - County
RD - Regional District
RM - Regional Municipality
1301 – First two digits identifies the province* or territory* and the other two, the CD
(*) – See appendix H for provincial and territorial codes
(Moncton) – Refers to cities or towns in that area and also differentiates cities with similar names eg. Saint John

Rural CDs

The pattern observed in the location of urban "best-served" and "worst-served" CDs was partially repeated in the rural CDs. Table 4.7b shows that half of the rural "best-served" CDs were in Quebec while the "worst-served" CDs were widely spread across the country.

The percentage increase in population from 1991 to 1996 was about four and a half times as great in the "worst-served" CDs as in the "best-served" CDs. Population density was also about two times higher in the "worst-served" CDs.

Similarly, the percentage of Aboriginal population living in the "worst-served" CDs was four times as great as in the "best-served" CDs. Unpredictably, ASMR were slightly higher in the "best-served" CDs than in the "worst-served" CDs. The same trend was observed with IMR, although the difference was marginal. Lastly, TFR were higher in "worst-served" CDs than in the "best-served" CDs.

This chapter has presented the results of the study with a focus on detecting the changes that have taken place from 1993 to 1999. The results of classifying areas as "under-served" or "well-served" and selected socio-economic characteristics of these areas were also presented.

Table 4.7b: Selected Characteristics of "Best-Served and "Worst-Served" Census Divisions (CD) (Rural Areas)

"Best-Served Rural CDs"	A	B	C	D	E	F	G	H	I
2403 La Côte-de-Gaspé[1] (Gaspé, QC)	287.8	20,851	0	5.0	1.0	43,405	791.5	1.36	6.5
2412 Rivière-du-Loup[2] (QC)	270.9	32,120	2	25.3	0.2	42,680	653.3	1.52	5.4
2406 Avignon[3] (Gaspé Peninsula, QC)	270.5	15,898	3	4.4	11.6	40,935	722.2	1.73	3.6
1006 Division no. 6 (Gander, NF)	258.2	39,118	-3	2.2	1.1	44,464	773.6	1.25	8.3
2488 Abitibi[4] (Amos, QC)	245.3	25,280	0	3.2	2.2	45,654	740.0	1.87	3.8
1214 Antigonish Co. (Antigonish, NS)	230.1	19,554	2	13.3	1.6	50,233	677.0	1.62	8.8
2401 Les Iles-de-la-Madeleine[5] (QC)	217.4	13,802	-1	68.2	0.0	45,576	683.1	1.28	6.8
5945 Central Coast RD[6] (BC)	229.5	3,921	13	0.2	55.4	41,861	936.9	2.18	16.0
5905 Kootenay Boundary RD[7] (BC)	209.7	32,906	6	4.2	1.5	50,028	724.5	1.51	4.3
5927 Powell River RD[8] (BC)	205.5	19,936	8	3.9	4.2	51,176	644.6	1.69	7.6
Weighted Averages (except column B)	**244.9**	**22,338****	**1.91**	**11.5**	**3.10**	**45,939**	**720.6**	**1.53**	**6.3**
"Worst-Served Rural CDs"									
4712 Division no. 12 (Rosetown, SK)[9]	45.0	24,454	0	0.2	8.8	48,555	605.1	1.91	10.8
3552 Sudbury District (ON)	43.2	25,457	-3	0.1	6.2	48,960	815.6	1.67	9.8
2463 Montcalm[10] (QC)	39.4	38,053	17	9.9	0.2	38,768	776.1	1.94	2.0
2448 Acton[11] (Acton Vale, QC)	39.2	15,303	5	2.0	0.2	41,527	648.4	1.93	5.0
2474 Mirabel (QC)	30.9	22,689	26	5.1	0.2	45,965	818.5	1.97	5.8
1308 Kent[12] Co. (Richibucto, NB)	28.0	32,094	1	1.1	5.2	37,921	601.3	1.43	2.9
4619 Division no. 19 (NE Manitoba)[13]	27.2	14,722	18	0.0	93.8	24,757	927.6	4.22	7.7
4612 Division no. 12 (Beausejour, MB)[14]	26.7	18,708	8	1.0	2.8	54,425	661.9	1.72	6.5
6108 Kitikmeot Region[15] (NT)	19.7	5,067	16	0.0	88.3	43,000	783.9	3.13	17. 3
4610 Division no.10 (MB)[16]	11.2	8,901	11	0.2	2.8	59,444	391.3	1.83	5.3
Weighted Averages (except column B)	**34.1**	**20,544****	**9.07**	**19.5**	**11.98**	**43,486**	**712.5**	**1.99**	**6.1**

Source: Columns B, C, D, E & F are based on Profile Series Data of 1996 Census; Columns F, G, H & I is from Table 8.1 of the Vital Statistics Compendium, 1996, Statistics Canada, Catalogue 84-214-XPE

Notes on Table 4.7b:

- "Best-served" refers to CDs with the highest ratio of physicians and vice versa for "Worst-served".

Column A depicts Physician-to-Population Ratios
Column B portrays 1996 Population of CDs
Column C depicts the Percentage Change in Population 1991-1996
Column D portrays Population Density of CD (population per square kilometre)
Column E portrays Percentage of Aboriginal Population
Column F refers to Average Family Income
Column G refers to Age Standardized Mortality Rate
Column H refers to Total Fertility Rate
Column I refers to Infant Mortality Rate

- According to the Vital Statistics Compendium 1996, rates in columns G, H & I were derived based on 3-year averages in the numerator and the 1995 population estimate in the denominator. This was done to prevent year-to-year fluctuations in CDs with small populations (see source for further discussion).
- % Aboriginal population was derived by dividing Aboriginal population in CD by population of CD e.g. 1006 Division No. 1 (NF) 445/39,118*100.
- Average family income was derived from the ALL CENSUS FAMILIES 20% sample data
- ASMR refers to the number of deaths per 100, 000 population – the above rates are for both male & female
- TFR refers to the average number of live births a woman can be expected to have in her lifetime.
- IMR refers to the number of infant deaths per 1,000 live births

** - unweighted average
1 – in the Gaspé Peninsula
2 – North East of Québec City
3 – in the Gaspé Peninsula
4 – North of Val-d'Or
5 – South of the Gulf of St. Lawrence
6 – Central Coast of British Columbia
7 – Grand Forks Area of British Columbia
8 – Mainland British Columbia (Northwest of Vancouver)
9 – West of Saskatoon
10 – South of Mont-Tremblant
11 – West of Sherbrooke in the Montérégie Region of Québec
12 – North of Moncton
13 – West of Lake Winnipeg and Lake Manitoba
14 – East of Winnipeg
15 – Cambridge Bay Area in Northwest Territories (Region is now part of Nunavut)
16 – South of Winnipeg in the Whitehorse Plains
RD - Regional District
1006 - First two digits identifies the province* or territory* and the other two, the CD
(*) – See appendix H for provincial and territorial codes
(Gander) – Refers to cities or towns in that area

Chapter Five

DISSCUSSION AND CONCLUSIONS

This final chapter will present a summary of the study results and discuss its implications. In addition the study limitations and some recommendations on possible research projects will be presented.

5.1 Summary of Results and Discussion

The study revealed that the Canadian population increased about 6% from 1991 to 1996. Also, the number of physicians declined by 0.9% and the percentage of the population less than 5 km from the nearest physician increased marginally by 0.5% from 1993 to 1999. Furthermore, there was a 4.5% decline in percentage of the population 5 to 24 km from the nearest physician during the same period. On the other hand, there were no changes in percentages of the population 25 km and beyond, from the nearest physician. Lastly, the physician-to-population ratio for the country decreased by 6% from 1993 to 1999. A reduction in the number of physicians coupled with the increase in population is the reason for this decline.

With regards to the relationship between province and distance traveled shorter distances were observed in Ontario, Quebec and British Columbia. These provinces also had high physician-to-population ratios and

are considered highly urbanized because they have a large proportion of communities with population above 50,000.

It is plausible to conclude from tables 4.2 and 4.3 that both physician and population movements (in or out of an area) may affect distance traveled and physician-to-population ratios in diverse ways. For instance tables 4.2 and 4.3 reveal that while proximity to physicians and physician-to-population can fall or rise simultaneously, they can also increase or decrease separately. The trend in Nova Scotia from 1993 to 1999 is the most noteworthy example of physician-to-population ratio decreasing while proximity to physicians improved at the same time.

Distance to the nearest physician was greater in the territories than in provinces and the physician-to-population was also lower. Incidentally, the territories have high concentrations of Aboriginal people[7]. In 1996, 51% of Northwest Territories and 12% of the Yukon population reported single Aboriginal origin as ancestry (47, 48). Based on the above and the fact that Aboriginal people have relatively high health needs it is a concern that the supply of physicians in this area is inadequate.

With regards to community size, a much greater percentage of the population in the CMA/CA areas were still within a relatively shorter distance from the nearest physician, compared to those living in the non-CMA/CA

[7] Aboriginal people refers to those who reported identifying themselves with at least one Aboriginal group, that is North American Indian, Metis or Inuit. Also included are all those who reported being a Treaty Indian or a Registered Indian as defined by the Indian Act of Canada, as well as members of an Indian Band or First Nations.

areas. The physician-to-population ratios decreased in most CMA/CAs while the reverse occurred in the non-CMA/CA areas. Despite these trends, the physician-to-population ratios in CMA/CA areas were still higher than those of non-CMA/CA areas.

Income had little or no effect on the distance to the nearest physician in the more urbanized EAs. On the other hand, a clear gradient by income was uncovered in the less urbanized and rural EAs. In general distance increased as income quintile decreased to lower levels. Even though the physician-to-population ratios improved in the less urbanized and rural EAs the ratios were still lower compared that of the more urbanized EAs. A reclassification of less urbanized/rural and more urbanized did not alter this trend. Despite the existing gap between the more urbanized and less urbanized/rural EAs, there are also signs of increasing equity in the lower three income quintiles in the less urbanized/rural EAs as depicted in figure 4.2a. In the highest income quintiles (fourth and fifth) the physician-to-population ratio decreased quite sharply. The decline was due partly to an increase in population in and a decline in the number of physicians.

Another interesting observation from figure 4.2a, which supports the need to measure both physician proximity and supply is that although the proximity measure was less sensitive in exposing changes in urban areas the supply measure was able to recognise the changes.

In terms of latitude north distance to the nearest physician was shorter in lower latitudes and longer in the higher latitudes of the country. Between

1993 and 1999 the percentage of the population less than 5 km from a physician increased (though not substantially) below latitude 55°, but decreased at latitude 55° and beyond. Although the physician-to-population ratio increased at high latitudes the ratios were still lower than those at low latitudes. As expected, distance to specialists differed according to the number of physicians in the specialty groups. Shorter distances were observed in specialties with more physicians.

The modest correlation coefficient of -0.49 derived between average distance (proximity) and physician-to-population ratios (supply) in CDs suggests that the two approaches are measuring similar but different things.

This study also revealed that population growth in the urban "worst-served" CDs was much greater than in the "best-served" CDs. The consequences of this and possibly an explanation to such CDs being "worst-served" may be that it takes a while for physicians to arrive in such booming areas.

Differences in population density between the "best-served" and "worst-served" in urban areas are clearly evident from a quick glance at table 4.7a. The reason for this difference may be due to the urbanization between the two areas. Thus it is possible that the "best-served" CDs are located in mainly large urban areas while the reserve may be true for the "worst-served" CDs. In contrast, the variability between these two areas in the rural areas was less pronounced and could be due to similarities in rural characteristics.

5.2 Implications

This study has demonstrated that the degree of urbanization of communities and provinces/territories dictates to a large extent the location choices of physicians in Canada. The tendency for physicians to situate their practices in urban areas has led to an uneven distribution of physicians in the country. Several studies have also documented the unequal distribution of physicians in rural and other non-urban locations, along with its associated problems in the provision of health services in such areas (10, 11, 12, 13, 14). Invariably, people living in rural areas are forced to travel longer distances to access physician services.

How far north a person lives also greatly influences the distance traveled to the nearest doctor. Living in the more northerly areas of the country is associated with greater distance to access physician services and vice versa for those residing in lower latitudes. The communities in northern parts of the country are generally small, widely dispersed and remote. These characteristics have contributed to a pattern whereby Canadians living in these areas have always found physician services less accessible than their city-dwelling counterparts (49). It is therefore not surprising that a high percentage of the population living in high latitudes have to travel at least 100 km or more to the nearest doctor.

People who live in northern and rural areas accept distance as a fact of life, and are accustomed to travelling considerable distances for many purposes. Despite the difference in perception of travel distance in rural and

urban areas, actual distance to the nearest physician is important particularly in instances where people do not have a means of transportation, in cases where roads are not accessible all year or in cases of emergency.

The growth of the Canadian population coupled with the reduction in number of physicians during the study period explains why the physician-to-population ratio declined in most jurisdictions of the country. The reduction in the number of physicians can be ascribed to a number of reasons among which are government policies (e.g. reducing enrolment at medical schools), physician emigration, mortality and retirement. It should be clarified that other factors like physician productivity and full/part time status also affect the effective physician-to-population ratio.

As reiterated in section 5.1 the need to measure both physician proximity and supply require special attention since either measure can change regardless of the situation of the other. The Nova Scotia experience from 1993 to 1999 for instance can be explained by a combination of inter and intra provincial migration to urban centers and the fact that moving to a city results in people living closer to physicians. This is because physicians tend to locate increasingly in urban areas and thus any movement towards urban centres will undoubtedly improve proximity. Therefore to facilitate effective planning both measures need to be monitored and assessed concurrently and frequently.

Also, it can be argued that in areas of rapid population growth the need to ensure a commensurate supply of physicians in relationship to growth rates

is very real and important. Such a step may be the difference in reducing the lag time for physicians to show up booming areas.

Lastly, it is clear from the above discussion that access in terms of distance traveled to the nearest physician is gradually getting worse for Canadians who do not live in urban areas (non-CMA/CA areas and high latitudes) of the country.

5.3 Limitations of Study

As with any research endeavour, this study has some shortcomings that need to be addressed. Since this analysis is for the most part updating the previous study undertaken by Ng et al. (in order to assess the degree of change), some of the weaknesses of the earlier analysis have been inherited.

It cannot be over emphasised that "aerial distance to the nearest physician is a rather crude indicator of geographic accessibility to physician services, and clearly underestimates the overland distance patients must travel on city streets and country roads" (10). This is especially the case in instances where physical barriers like mountains and lakes exist. For future studies of this kind Geographical Information Systems[8] (GIS) technology could be used to measure actual road distances more accurately and allow for impediments like towns and bridges to be measured.

Moreover, considering distance alone ignores other elements of access to physicians. In short, proximity and access are not necessarily

[8] A GIS is a computer system capable of assembling, storing, manipulating, and displaying geographically referenced information, that is data identified according to their locations.

synonymous, nor does equal access necessarily lead to equal health outcomes. Financial barriers have been largely removed in Canada, but other factors such as cultural and language sensitivities, supply of physicians, the location of physician offices and hours of operation are real and need to be considered (especially when the Canadian health care system is contrasted with the American, which is premised on an ability to pay). These factors are difficult to assess and their effects often interdependent, so it is hard to rank them in order of importance. However, distance to the nearest physician can surely be rated among the top issues affecting access in the rural and northern parts of the country. The imbalance in physician supply in remote and northern parts of the country justifies the current analysis on distance and makes an analysis on distance a useful exercise in assessing potential access.

Also, since EA representative points were used for population locations, distance to the nearest physician was not calculated precisely for every person. Given that residents may be located anywhere within an EA, some people may be closer to the nearest physician than others. Likewise, for people living near inter-provincial boundaries the nearest physician may be in the adjoining province. As noted by Pong and Pitblado, this approach to computing distance by EA centroids underestimates the actual distances traveled in rural areas (25). EAs in rural areas encompass relatively larger areas than is the case in urban settings, and since rural populations are more dispersed than city dwellers, distance estimate imprecision will certainly be

greater in rural areas. The more rural an area, the larger the EA, and the greater the underestimation.

Another significant limitation relates to the assumption that physician practices in rural areas will be centrally located in village centres where the bulk of the population is situated. The effects of this assumption are unknown.

The 1999 Canadian Medical Association Physician Master File is built from many different data sources, which include information on association members and non-members, and information from provincial licensing bodies (Colleges of Physicians and Surgeons); it is believed to include all physicians licensed to practice medicine in Canada. However, for several reasons, the directory may not fully reflect the geographical availability of physicians. Some physicians may practice in more than one location, including occasional days in northern or isolated areas, while others may not work full time or may not see patients at all, for example if they are engaged in research or administration.

Additionally, some of the physician postal codes may refer to the physician's home address (might cause physician to be counted in the wrong area), which could lead to overestimates of the physician-to-population ratios in more affluent areas. Access may also be overstated to the extent that some practices are "closed" to new patients and thus unavailable to part of the population. Furthermore, as pointed out by Buske and Newton, the accurate measurement of physician attrition out of the active pool may be problematic (37). This is due mainly to the time lag that occurs between the

occurrence of an event and when it gets registered in the database. The situation may be compounded further if there is little or no incentive for physicians to report changes in their practice patterns or where no strong mandate exists for physician organizations to document such changes. Also, the Federal/Provincial Advisory Committee on Health Manpower and the National Specialty Physician Review ("population-to-physician") ratios used for classifying areas as "well-served" or "under-served" may not be appropriate. The former dates back to 1985 while the latter came out in 1988. Despite the continued use of these ratios (for instance in the Pitblado and Pong 1999 study) there may be a need for a revision of these benchmarks.

Lastly, using recommended ratios that tend to be national standards to classify smaller administrative units such as CDs into "well-served" and "under-served" areas may not be appropriate, because people travel. Thus such categorizations may point falsely to a deplorable state of affairs.

5.4 Conclusions and Recommendations

Although there were no dramatic changes from 1993 to 1999, this study has documented that disparities still persist between urban and rural areas in distance traveled to the nearest physician. It is clear that the rural population have poorer access to physicians. As mentioned earlier the distribution of physicians in the country favours the urban population. The effect of this distribution may perhaps be that rural and small town population not seeking preventive or specialist care as required, since may be resulting in

unfavourable outcomes. Thus unless major initiatives are taken to assess and address this situation it will continue to persist.

Establishing a few medical schools in rural parts of the country (like the proposed two new schools in northern Ontario) might help redress this imbalance. As pointed out by McKendry, physicians who grew up or received their medical training in rural areas are more likely to choose to practice in rural and remote communities (50, page viii).

Also viable incentive programs like student loan repayment in return for specified amount of services need to be instituted or remodelled. In like manner establishing special recruitment programs for foreign trained physicians to practice under contract in some of the "under-served" areas might resolve the distribution of physicians in Canada.

Further research using the proximity approach should continue since it provides a meaningful way for assessing physician supply in the rural areas of the country. Of all the questions that remain unanswered, two major issues need to be reiterated for further inquiry:

- are people delaying their trips to access physician services due to long travel distance, and what, if any are the effects of such delays on health outcomes and status,

- this study needs to be replicated in the next 5-10 years to ascertain whether proximity to physicians is still a relevant health policy problem.

This study should be repeated because as mentioned earlier the results of such a study will help provide more information that could be used to establish a clear trend on proximity to physicians. Thus more studies over a longer period will average out fluctuations in data and hence provide a better representation of the situation. Furthermore, having more concrete data may perhaps convince decision makers to take the necessary steps to address the concerns of this study, since the lack of trend data cannot justifiably be used as a pretext for inaction. This might explain why major policy changes were not made to address the recommendations of the Ng et al study.

Finally, it should be mentioned that this study's principal contribution has been to update the information contained in the 1997 Ng et al. study thereby providing decision makers and policy analysts with relevant evidence-based source of information to support their work.

This chapter has presented a summary of the study results and discussed its implications. The study limitations and suggestions on possible research projects were presented as well.

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Appendix A - Definitions

Block-Face: Is defined as one side of a city street between two consecutive street intersections. Block-faces are also formed when streets intersect other visible physical features (such as railroads, power transmission lines and rivers) and when streets intersect enumeration area boundaries (43). Block–faces are defined only in large urban centres covered by Statistics Canada's street network files (43).

Census Metropolitan Area (CMA): "A large urban centre consisting of an urbanized core, with 100,000 or more inhabitants in that core (based on a previous census), and adjacent urban and rural areas that have a high degree of economic and social integration with the urbanized core. Once an area is designated as a CMA, it maintains that status even if its core population falls below the 100,000 threshold" (10,43). *In 1991 and 1996, there were 25 CMAs in Canada (43). Ottawa-Hull is an example of a CMA.*

Census Agglomeration (CA): "A small urban centre consisting of an urbanized core, with 10,000 or more inhabitants but less than 100,000 in that core (based on a previous census), and adjacent urban and rural areas that have a high degree of economic and social integration with the urbanized core. When the core of a CA attains a population of 100,000 the urban centre is re-designated as a CMA" (10,43). *In 1996, there were 115 CAs in Canada (43). Belleville is an example of a CA.*

Census Division (CD): Refers to the general term applied to areas established by provincial law, which are intermediate geographic areas between municipality (census subdivision) and the province level (43). CDs represent counties, regional districts, regional municipalities and other types of provincially legislated areas (43). In Newfoundland, Manitoba, Saskatchewan and Alberta, provincial law does not provide for these administrative geographic areas, therefore CDs have been created by Statistics Canada in cooperation with these provinces for the dissemination of statistical data. In the Yukon Territory, the CD is equivalent to the entire territory (43). *The Regional Municipality of Ottawa-Carleton is an example of a CD.*

Community Size (CMA/CA size): Defined using census metropolitan area and census agglomeration (CMA/CA) populations. Based on this definition, five classifications of community sizes were obtained: those with 1,000,000 or more inhabitants, 500,000 - 999,999, 100,000 - 499,999, 10,000 - 99,999 and non-CMA/CAs below 10,000 inhabitants. *In 1991, CMAs with more than a million inhabitants were Toronto, Montreal and Vancouver. However, in 1996 Ottawa-Hull joined the list.*

Enumeration Area (EA) "The census organizes geographical data in a "building block" system, where smaller geographical units may be added together to form larger units, which in turn form even larger units, until they all add up to the total of Canada. The smallest unit in this system is the EA - the geographic area canvassed, or enumerated, by one census representative. In rural areas, an EA can cover relatively wide reaches of land, but in urban areas, it is usually several city blocks. Each EA has a representative point that is used to provide a single longitude and latitude for the EA" (10,43). *Five or more city blocks could an example of an EA.*

Income Per Person-Equivalent (IPPE): EA income was based on a variable derived from the 1991 census. "IPPE takes into consideration the economies of scale possible when two or more people share a household. It uses the distribution of household sizes in an EA to adjust for the bias introduced by more conventional measures such as average household income. EA-level income information available from the census includes average household income (total EA income divided by the number of private households in that EA) and average personal income (total EA income divided by the population aged 15 and over in that EA). However, these two indicators do not account for the number of people per household. Two people sharing a residence do not require twice the income of a person living alone to maintain the same standard of living. Thus, an EA with relatively low average personal income, but many multi-person households, may have a standard of living similar to an EA with relatively high average personal income but many one-person households. The calculation of IPPE adjusts average household income for the bias introduced by the unequal distribution of household sizes across EAs" (10).

In 1996 census data IPPE was calculated as follows:
IPPE = total household income in an EA / person-equivalents,
Where person-equivalents =
1.00 (number of one-person households) +
1.25 (number of two-person households) +
1.55 (number of three-person households) +
1.88 (number of four-person households) +
2.10 (number of five-person households)+
2.33 (number of six-person households) +
2.55 (number of seven-person households)+

In 1991IPPE was calculated as follows:

1.00 (number of one-person households) +
1.36 (number of two-person households) +
1.72 (number of three-person households) +

1.98 (number of four-person households) +
2.30 (number of five-or more person households)

Less Urbanized and Rural Areas: In 1991 and 1996, CAs with less than 50,000 inhabitants were categorized as less urbanized and rural.

More Urbanized Areas: In 1991 and 1996, CAs and CMAs with more than 50,000 people were categorized as more urbanized areas.

Representative Point *("Centroids" in 1991census)*: A representative point is a single point that represents a linear feature (block-face) or an aerial feature (EA). The point's location generally indicates either dwelling concentrations or centrality (43).

Appendix B: Search Strategy - List of Key Words

MEDLINE - 1966 to October Week 5, 2001

1. Specialties, medical/ or professional practice location/ or health manpower/ or rural health/ or health services accessibility/ or medically underserved area/ (50088)
2. Health services accessibility/ or medically underserved/ or medically underserved area/ (19480)
3. Physician/ or medically underserved area/ (2646)
4. Physicians/sd, ma, td, ut [Supply & Distribution, Manpower, Trends, Utilization] (5364)
5. Physician patient ratio.mp. (2)
6. Physicians/ or Specialties, Medical/ or "Catchment Area (Health)"/ or Health Policy/ (75998)
7. Physician population ratio.mp. or "Catchment Area (Health)"/ or Health Policy/ (30709)
8. Physician population ratio.mp. (39)
9. Physician/ or distance.mp. [mp=title, abstract, registry number word, mesh subject heading] (44420)
10. Physician/ or distance/accessibility (0)
11. Physician/ or distance/ or accessibility/ (17236)
12. Physician/ or rural/ or distance/ (17236)
13. Physician/ or rural/ or distance/ or proximity/ (17236)
14. Physician/ or rural/ or distance/ or proximity/ or health services accessibility/ (17236)
15. Health manpower/ or physician supply/ or demand/ (5883)
16. (Health manpower.mp. and medically underserved area/) or distance/ [mp=title, abstract, registry number word, mesh subject heading] (17392)
17. (Health manpower and medically underserved area).mp. and distance/ [mp=title, abstract, registry number word, mesh subject heading] (26)
18. Explore North America/ (829568)
19. Explore Canada/ (64643)
20. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 11 or 12 or 13 or 14 or 15 or 16 (154095)
21. 19 and 20 (4693)
22. 18 and 20 (59123)
23. Health Services Accessibility/ or distance.mp. (61412)
24. 21 and 23 (973)
25. Limit 24 to English language (934)
26. *Health Services Accessibility/ (7500)
27. 25 and 26 (324)
28. From 27 keep 1-324 (324)

Appendix C: Physician-to-Population Ratios & Distance to Nearest Physician, By Province & Community Size, Canada,1999

Characteristics	Population		Physicians		Physician per 100,000 Population	Distance to nearest physician Mean	Distance to nearest physician Median	% of population by distance (km) to the nearest physician* <5	5-24	25-49	50-99	100-149	150+
		%		%		Km		%					
Canada	**28,846,761 (a)**	**100.0**	**56,775**	**100.0**	**197**	**3.2**	**0.5**	**87.3**	**11.0**	**1.2**	**0.3**	**0.1**	**0.1**
Newfoundland	551,792	1.9	907	1.6	164	6.0	1.2	72.5	24.0	3.0	0.2	0.4	0.3
Prince Edward Island	134,557	0.4	182	0.3	135	5.0	2.9	60.5	39.5	-	-	-	-
Nova Scotia	909,282	3.1	1,857	3.2	204	3.8	1.1	73.5	25.7	0.8	-	-	-
New Brunswick	738,133	2.5	1,187	2.0	161	4.6	1.8	66.9	32.6	0.5	-	-	-
Quebec	7,138,795	24.7	15,327	27.0	215	2.0	0.5	90.2	9.1	0.4	0.1	0.1	-
Ontario	10,753,573	37.2	20,837	36.7	194	1.8	0.5	91.1	8.5	0.2	0.1	-	-
Manitoba	1,113,898	4.8	2,081	3.6	187	5.8	0.5	78.9	16.4	2.4	1.4	0.6	0.2
Saskatchewan	990,273	3.4	1,540	2.7	156	8.8	0.5	68.6	18.6	11.0	1.5	0.1	0.2
Alberta	2,696,826	9.3	4,779	8.4	177	4.0	0.5	82.7	13.3	3.2	0.6	0.1	-
British Columbia	3,724,500	12.9	7,965	14.0	214	2.1	0.5	92.6	5.9	1.1	0.4	0.1	-
Yukon	30,766	0.1	47	0.1	153	23.5	2.5	54.8	28.0	3.9	3.9	3.5	6.0
Northwest Territories (b)	64,402	0.2	65	0.1	101	194.1	2.4	52.1	0.8	0.2	3.9	5.8	37.4
Community/CMA/CA size[$]													
1,000,000 or more	10,432,430	36.1	24,866	43.7	238	0.7	0.5	98.9	1.1	-	-	-	-
500,000-999,999	3,647,683	12.6	8,916	15.7	244	1.0	0.5	96.9	3.0	0.1	-	-	-
100,000-499,999	4,856,856	16.8	10,562	18.6	217	1.3	0.5	95.0	4.8	0.1	-	-	-
10,000-99,999	3,512,886	12.1	6,768	11.9	193	1.9	0.5	91.4	8.1	0.4	0.1	-	-
Non CMA/CA areas	6,396,906	22.1	5,663	9.9	89	10.6	3.8	54.7	38.0	4.9	1.2	0.5	0.7
CMA/CA size missing	-	-	-	-	-	-	-	-	-	-	-	-	-

Source: 1999 Canadian Medical Association Physician Master File and 1996 Census

(a) Population of Canada in 1996
(b) Population includes Nunavat
(+) In completed Kilometres
($) See Definitions
(-) Nil or zero or figures not appropriate or not applicable

Appendix C (continued). Canada, 1993

Characteristics	Population		Physicians		Physician per 100,000 Population	Distance to nearest physician		% of population by distance (km) to the nearest physician*					
						Mean	Median	<5	5-24	25-49	50-99	100-149	150+
		%		%		Km		%					
Canada	**27,296,859 (s)**	**100.0**	**57,291**	**100.0**	**210**	**3.1**	**0.5**	**96.8**	**11.5**	**1.2**	**0.3**	**0.1**	**0.1**
Newfoundland	568,474	2.1	1,139	2.0	200	6.7	1.2	72.4	24.0	2.5	0.1	0.3	0.8
Prince Edward Island	129,765	0.5	180	0.3	139	4.4	3.0	64.3	35.7	-	-	-	-
Nova Scotia	899,942	3.3	2,048	3.6	228	4.0	0.5	69.6	29.3	1.1	-	-	-
New Brunswick	723,900	2.7	1,090	1.9	151	5.1	2.4	62.8	35.5	1.7	-	-	-
Quebec	6,895,963	25.3	15,435	26.9	224	2.0	0.5	91.2	8.2	0.3	0.1	0.1	-
Ontario	10,084,885	36.9	20,760	36.2	206	1.8	0.5	90.7	8.9	0.3	0.1	-	-
Manitoba	1,091,942	4.0	2,239	3.9	205	6.2	0.5	78.4	16.8	2.5	1.2	0.2	0.7
Saskatchewan	988,928	3.6	1,547	2.7	156	8.3	0.5	67.9	20.5	10.0	1.3	0.1	0.2
Alberta	2,545,553	9.3	4,641	8.1	182	3.9	0.5	82.9	13.5	2.9	0.5	0.1	-
British Columbia	3,282,061	12.0	8,118	14.2	247	2.3	0.5	91.2	7.2	1.1	0.3	0.1	-
Yukon	27,797	0.1	40	0.1	144	23.6	2.1	68.4	13.6	4.6	4.0	4.3	5.0
Northwest Territories	57,649	0.2	54	0.1	94	155.2	1.2	57.3	0.7	0.2	3.9	6.5	31.4
Community/CMA/CA size[$]													
1,000,000 or more	8,622,790	31.6	22,109	38.6	256	0.7	0.5	99.1	0.9	-	-	-	-
500,000-999,999	4,412,478	16.2	11,881	20.7	269	1.0	0.5	96.5	3.5	-	-	-	-
100,000-499,999	4,214,504	15.4	10,260	17.9	243	1.3	0.5	93.8	6.1	0.2	-	-	-
10,000-99,999	3,817,442	14.0	7,181	12.5	188	1.8	0.5	91.2	8.3	0.4	0.4	-	-
Non CMA/CA areas	6,229,645	22.8	5,302	9.3	85	10.2	3.8	55.6	37.4	4.7	1.1	0.4	0.8
CMA/CA size missing	-	-	558	1.0	-	-	-	-	-	-	-	-	-

Source: 1993 Canadian Medical Association Physician Master File and 1991 Census

(s) Population of Canada in 1991
(+) In completed Kilometres
($) See Definitions
(-) Nil or zero or figures not appropriate or not applicable

Appendix D: Physician-to-Population Ratios & Distance to Nearest Physician, By Census Metropolitan Areas, Canada, 1999

Characteristics	Population	Physicians	Physician per 100,000 Population	Distance to nearest physician Mean (KM)	% of population by distance (km) to nearest physician* <5 %	≥5km %
All CMAs	**17,846,646**	**42,085**	**236**	**0.8**	**98.5**	**1.5**
Toronto	4,263,757	9,421	221	0.6	99.3	0.7
Montreal	3,326,510	8,092	243	0.7	99.3	0.7
Vancouver	1,831,665	4,598	251	0.7	99.7	0.3
Ottawa-Hull	1,010,498	2,755	273	1.1	94.6	5.4
Edmonton	862,597	1,898	220	1.5	93.2	6.8
Calgary	821,628	1,777	216	0.8	98.6	1.4
Quebec City	671,889	2,136	318	0.9	98.3	1.7
Winnipeg	667,209	1,619	243	1.1	96.1	3.9
Hamilton	624,360	1,486	238	0.7	99.1	0.9
London	398,616	1,231	309	0.9	96.2	3.8
Kitchener	382,940	524	137	0.8	99.3	0.7
St. Catharines- Niagara	372,406	473	127	1.2	97.2	2.7
Halifax	332,518	1086	327	1.4	93.2	6.8
Victoria	304,287	858	282	0.8	99.4	0.6
Windsor	278,685	409	147	0.9	96.6	3.4
Oshawa	268,773	356	132	1.1	97.1	2.9
Saskatoon	219,056	614	280	2.2	90.5	9.5
Regina	193,652	398	206	1.2	97.0	3.0
St. John's	174,051	466	268	1.2	96.3	3.7
Sudbury	160,488	282	176	1.4	94.1	5.9
Chicoutimi - Jonquière	160,454	299	186	1.3	95.9	4.1
Sherbrooke	147,384	551	374	0.9	98.8	1.2
Trois-Rivières	139,956	286	204	1.0	97.3	2.7
Saint John	125,705	266	473	2.4	83.1	16.9
Thunder Bay	125,562	204	162	1.8	92.7	7.3

Source: 1999 Canadian Medical Association Physician Master File and 1996 census
Note: In all CMAs, median distances to the nearest physician were 0.5km. See Methods

Appendix D (continued). Canada, 1993

Characteristics	Population	Physicians	Physician per 100,000 Population	Distance to nearest physician Mean (KM)	% of population by distance (km) to nearest physician* <5 %	≥5km %
All CMAs	**16,665,360**	**42,667**	**257**	**0.9**	**97.4**	**2.6**
Toronto	3,893,046	9,130	235	0.7	98.8	1.3
Montreal	3,127,242	8,249	264	0.7	99.3	0.7
Vancouver	1,602,502	4,730	295	0.7	99.4	0.6
Ottawa-Hull	920,857	2,711	294	1.0	95.2	4.8
Edmonton	839,924	1,919	228	1.4	93.3	6.7
Calgary	754,033	1,655	219	1.0	97.4	2.7
Winnipeg	652,354	1,768	271	0.9	96.4	3.6
Quebec City	645,550	2,297	356	0.8	98.9	1.1
Hamilton	599,760	1,531	255	0.7	99.1	0.9
London	381,522	1,305	342	0.9	96.3	3.7
St. Catharines- Niagara	364,552	496	136	1.2	96.5	3.5
Kitchener	356,421	528	148	0.7	99.3	0.7
Halifax	320,501	1,249	390	1.8	87.5	12.5
Victoria	287,897	1,007	350	1.1	95.8	4.2
Windsor	262,075	396	151	1.0	96.2	3.8
Oshawa	240,104	307	128	0.9	96.5	3.5
Saskatoon	210,023	622	296	2.3	90.3	9.7
Regina	191,692	411	214	1.1	96.4	3.6
St. John's	171,859	581	338	1.4	95.2	4.8
Chicoutimi - Jonquière	160,928	292	181	1.6	92.2	7.8
Sudbury	157,613	268	170	1.6	92.0	8.0
Sherbrooke	139,194	654	470	0.9	97.0	3.0
Trois-Rivières	136,303	271	199	1.0	95.8	4.2
Saint John	124,981	272	218	2.7	82.4	17.6
Thunder Bay	124,427	218	175	1.7	92.7	7.3

Source: 1993 Canadian Medical Association Physician Master File and 1991 census
Note: In all CMAs, median distances to the nearest physician were 0.5km. See Methods

Appendix E: Physician-to-Population Ratios & Distance to Nearest Physician, By Income Quintile & Latitude, Canada, 1999

Characteristics	Population		Physicians		Physician per 100,000 Population	Distance to nearest physician		% of population by distance (km) to the nearest physician*					
						Mean	Median	<5	5-24	25-49	50-99	100-149	150+
		%		%		Km				%			
Canada	**28,846,761 (a)**	**100.0**	**56,775**	**100.0**	**197**	**3.2**	**0.5**	**87.3**	**11.0**	**1.2**	**0.3**	**0.1**	**0.1**
More Urbanized Areas[§] (>50,000) Income quintiles[~]													
All	19,592,684	100.0	45,562	100.0	233	0.9	0.5	97.4	2.4	-	-	-	-
1 (lowest income quintile)	3,943,491	20.1	11,618	25.4	295	0.7	0.5	98.9	0.9	-	-	-	-
2	3,925,624	20.0	8,182	17.9	208	0.9	0.5	97.1	2.7	-	-	-	-
3	3,910,024	19.9	7,668	16.8	196	1.1	0.5	96.2	3.6	-	-	-	-
4	3,909,908	19.9	6,738	14.7	172	1.0	0.5	96.7	3.1	-	-	-	-
5 (highest)	3,890,914	19.8	11,030	24.2	283	0.8	0.5	98.2	1.7	-	-	-	-
Income quintile missing	12,723	-	326	0.7	-	-	-	-	-	-	-	-	-
Less Urbanized/Rural Areas[‡] (<50,000) Income quintiles[~]													
All	9,254,077	100.0	11,111	100.0	120	7.9	1.7	65.6	29.0	3.5	0.8	0.3	0.2
1 (lowest income quintile[~])	1,874,263	20.2	2,686	24.1	143	12.1	2.0	57.8	32.8	5.2	2.2	0.7	0.8
2	1,831,396	19.7	2,142	19.2	117	7.6	1.8	63.2	32.4	3.3	0.3	0.2	0.2
3	1,830,405	19.7	1,830	16.4	100	7.2	1.7	66.3	29.8	2.9	0.4	0.1	0.2
4	1,828,552	19.7	2,125	19.1	116	5.5	1.6	69.8	27.1	2.2	0.3	0.1	0.1
5 (highest)	1,778,956	19.2	2,238	20.1	126	4.7	1.3	74.8	22.1	2.3	0.4	0.1	-
Income quintile missing	110, 505	1.1	90	0.8	-	-	-	-	-	-	-	-	-
Latitude - North													
40-<45°	9,365,308	32.4	18,242	32.1	195	1.4	0.5	92.0	8.1	-	-	-	-
45-<50°	14,870,753	51.5	30,973	54.5	208	2.3	0.5	88.0	11.5	0.7	-	-	-
50-<55°	4,195,001	14.5	7,121	12.5	170	6.1	0.5	78.3	15.3	4.8	1.0	0.4	0.3
55-<60°	317,249	1.1	321	0.5	101	20.3	1.7	60.1	17.2	9.5	8.7	2.2	2.5
60-<65°	77,142	0.2	111	0.2	144	64.5	1.2	62.0	11.5	1.7	3.8	4.5	16.2
65-<70°	17,399	-	7	-	40	299.1	298.7	26.7	-	-	4.2	11.4	58.0
70+°	3,909	-	-	-	-	842.3	838.9	-	-	-	-	-	100.0

Source: 1999 Canadian Medical Association Physician Master File and 1996 Census

(a) Population of Canada in 1996
(+) In completed kilometres
($) See Definitions
(~) See Definitions
(-) Nil or zero or figures not appropriate or not applicable

Appendix E (continued). Canada. 1993

Characteristics	Population		Physicians		Physician per 100,000 Population	Distance to nearest physician		% of population by distance (km) to the nearest physician*					
						Mean	Median	<5	5-24	25-49	50-99	100-149	150+
		%		%		Km				%			
Canada	**27,296,859 (s)**	**100.0**	**57,291**	**100.0**	**210**	**3.1**	**0.5**	**86.8**	**11.5**	**1.2**	**0.3**	**0.1**	**0.1**
More urbanized areas (>50,000) Income quintiles~													
All	17,918,831	100.0	45,524	100.0	254	0.9	0.5	97.1	2.9	-	-	-	-
1 (lowest)	3,581,486	20.0	7,534	16.5	210	0.8	0.5	98.1	1.9	0.1	-	-	-
2	3,557,161	19.9	5,906	13.0	166	1.0	0.5	96.7	3.2	0.1	-	-	-
3	3,552,496	19.8	6,164	13.5	174	1.0	0.5	96.4	3.6	-	-	-	-
4	3,545,302	19.8	7,066	15.5	199	1.0	0.5	96.4	3.6	-	-	-	-
5 (highest)	3,524,722	19.7	18,256	40.1	518	0.8	0.5	97.9	2.1	-	-	-	-
Income Quintile missing	157,664	0.9	598	1.3	-	-	-	-	-	-	-	-	-
Less Urbanized/Rural Areas (<50,000) Income quintiles~													
All	9,378,028	100.0	11,767	100.0	125	7.4	1.5	67.2	28.0	3.3	0.7	0.3	0.5
1 (lowest)	1,912,480	20.5	2,350	20.0	123	14.2	3.4	54.5	33.9	6.5	2.5	0.8	1.8
2	1,860,652	19.8	2,033	17.3	109	8.1	1.8	63.8	31.8	3.3	0.5	0.1	0.5
3	1,873,236	20.0	2,187	18.6	117	5.9	1.5	69.1	27.5	2.7	0.3	0.3	0.1
4	1,860,220	19.8	2,217	18.8	119	4.4	1.3	72.6	25.2	1.9	0.2	-	-
5 (highest)	1,802,032	19.2	2,902	24.7	161	4.3	1.1	75.7	21.9	2.1	0.2	0.1	-
Income quintile missing	69,407	0.7	78	0.6	-	-	-	-	-	-	-	-	-
Latitude - North													
40-<45°	8,754,188	32.1	18,372	32.1	210	1.4	0.5	91.3	8.7	-	-	-	-
45-<50°	14,167,419	51.9	31,593	55.1	223	2.3	0.5	87.4	11.8	0.7	0.1	-	-
50-<55°	3,989,181	14.6	6,946	12.1	174	6.2	0.5	77.2	16.7	4.5	0.8	0.3	0.5
55-<60°	297,608	1.1	283	0.5	95	22.2	1.5	61.1	15.0	9.8	8.7	2.2	3.2
60-<65°	69,304	0.3	93	0.2	134	47.0	1.3	69.6	6.0	2.0	3.7	4.7	14.0
65-<70°	15,894	0.1	4	-	25	249.9	137.5	31.1	-	-	5.0	15.3	48.6
70+°	3,265	-	-	-	-	851.3	839.9	-	-	-	-	-	100.0

Source: 1993 Canadian Medical Association Physician Master File and 1991 Census

(s) Population of Canada in 1991
(+) In completed kilometres
($) See Definitions
(~) See Definitions
(-) Nil or zero or figures not appropriate or not applicable

Appendix F: Physician-to-Population & Distance to Nearest Physician, By Selected Characteristics, Canada, 1999

Characteristics	Population		Physicians		Physician per 100,000 Population	Distance to nearest physician		% of population by distance (km) to nearest physician*					
						Mean	Median	<5	5-24	25-49	50-99	100-149	150+
		%		%		Km		%					
Canada	**28,846,761 (a)**	**100.0**	**56,775**	**100.0**	**197**	**3.2**	**0.5**	**97.3**	**11.0**	**1.2**	**0.3**	**0.1**	**0.1**
More Urbanized Areas (> 10,000) Income quintiles~													
All	22,449,855	100.0	51,038	100.0	227	1.0	0.5	96.6	3.3	0.1	-	-	-
1 (lowest income quintile)	4,557,052	20.2	13,342	26.1	293	0.9	0.5	97.9	1.9	0.2	-	-	-
2	4,494,504	20.0	9,424	18.4	210	1.1	0.5	96.1	3.8	0.1	-	-	-
3	4,483,738	19.9	8,398	16.4	187	1.2	0.5	95.2	4.6	0.1	-	-	-
4	4,481,466	19.9	7,639	14.9	170	1.1	0.5	96.0	3.9	-	-	-	-
5 (highest)	4,415,476	19.6	11,872	23.2	269	0.9	0.5	97.7	2.3	-	-	-	-
Income quintile missing	17,619	-	363	0.7	-	-	-	-	-	-	-	-	-
Less Urbanized /Rural Areas (< 10,000) Income quintiles													
All	6,396,906	100.0	5,635	100.0	88	10.6	3.8	54.6	38.0	4.9	1.2	0.4	0.5
1 (lowest income quintile~)	1,260,702	19.7	962	17.0	76	17.0	7.3	41.6	45.1	7.2	3.3	1.1	1.3
2	1,262,516	19.7	900	15.9	77	10.0	4.6	51.6	42.2	4.6	0.4	0.3	0.4
3	1,256,691	19.6	1,100	19.5	88	9.5	3.5	56.3	38.3	4.1	0.5	0.1	0.4
4	1,256,994	19.6	1,224	21.7	97	7.2	2.8	60.3	35.4	3.2	0.4	0.2	0.1
5 (highest)	1,254,394	19.6	1,396	24.7	111	6.1	2.2	67.2	28.6	3.2	0.6	0.1	-
Income quintile missing	105, 609	1.6	53	0.9	-	-	-	-	-	-	-	-	-

Source: 1999 Canadian Medical Association Physician Master File and 1996 Census

(a) Population of Canada in 1996
(+) In completed kilometres
($) See Definitions
(~) See Definitions
(-) Nil or zero or figures not appropriate or not applicable

Appendix F: (continued) ,Canada, 1993

Characteristics	Population		Physicians		Physician per 100,000 Population	Distance to nearest physician Mean	Distance to nearest physician Median	% of population by distance (km) to nearest physician* <5	5-24	25-49	50-99	100-149	150+
		%		%		Km		%					
Canada	**27,296,859 (s)**	**100.0**	**57,291**	**100.0**	**210**	**3.1**	**0.5**	**86.8**	**11.5**	**1.2**	**0.3**	**0.1**	**0.1**
More Urbanized Areas (> 10,000) Income quintiles~													
All	21,067,955	100.0	48,478	100.0	230	1.0	0.5	96.0	3.8	-	-	-	-
1 (lowest income quintile)	4,284,571	20.3	12,226	25.2	285	0.9	0.5	96.5	3.2	0.1	-	-	-
2	4,220,211	20.3	5,313	10.9	126	1.1	0.5	95.4	4.3	0.1	-	-	-
3	4,218,327	20.0	5,415	11.1	128	1.1	0.5	95.3	4.5	-	-	-	-
4	4,205,927	19.9	6,899	14.2	164	1.0	0.5	95.5	4.4	-	-	-	-
5 (highest)	4,138,356	19.6	18,450	38.0	446	0.8	0.5	97.1	2.7	-	-	-	-
Income quintile missing	563	-	175	0.3	-	-	-	-	-	-	-	-	-
Less Urbanized /Rural Areas (< 10,000) Income quintiles~													
All	6,228,904	100.0	5,302	100.0	85	6.4	3.8	55.5	41.3	2.8	0.2	-	-
1 (lowest income quintile~)	1,244,626	19.9	734	13.8	59	10.0	9.0	35.7	57.7	6.0	0.4	-	-
2	1,247,667	20.0	971	18.3	78	6.9	4.6	51.5	45.1	2.8	0.3	-	-
3	1,248,276	20.0	1,079	20.3	86	5.7	3.1	58.5	39.0	2.3	-	-	-
4	1,247,324	20.0	1,151	21.7	92	4.9	2.6	63.4	34.9	1.5	-	-	-
5 (highest)	1,239,720	19.9	1,353	25.5	109	4.4	2.1	68.6	29.8	1.4	-	-	-
Income quintile missing	1,291	-	14	0.2	-	-	-	-	-	-	-	-	-

Source: 1993 Canadian Medical Association Physician Master File and 1991 Census

(s) Population of Canada in 1991
(+) In completed kilometres
($) See Definitions
(~) See Definitions
(-) Nil or zero or figures not appropriate or not applicable

Appendix G: Distance to Nearest Physician, By Medical Specialty, Canada, 1999

Specialty	Physicians	%	Distance to nearest Physician (KM) Mean	Median	% of population by distance (km) to nearest physician+ <5	5-24	25-49	50-99	100-199	200-299	300+
All physicians	58,775	100.0	3.2	0.5	87.3	11.0	1.2	0.3	0.2	-	0.1
General practice/Family medicine	28,743	50.6	4.6	0.5	83.1	13.6	1.9	1.0	0.2	0.1	0.1
Psychiatry	3,774	6.6	18.6	2.6	63.9	20.4	6.6	4.9	2.8	0.7	0.7
Internal medicine	2,372	4.1	17.6	2.9	62.6	22.7	6.8	4.6	2.2	0.5	0.6
Anesthesia	2,266	3.9	23.2	3.0	62.4	19.8	6.8	5.6	3.2	1.2	1.0
Pediatrics	2,029	3.5	19.8	2.8	62.9	19.5	7.1	6.2	3.0	0.8	0.5
Diagnostic radiology	1,846	3.2	19.7	3.2	61.5	22.7	7.1	4.7	2.8	0.5	0.7
General surgery	1,820	3.2	14.5	2.9	64.8	23.5	5.8	3.4	1.5	0.2	0.5
Obstetrics/Gynecology	1,563	2.7	20.0	3.4	59.2	23.6	7.3	5.9	2.6	0.6	0.7
Orthopedic surgery	1,072	1.8	26.0	4.0	55.7	23.8	8.2	6.4	3.8	0.9	1.2
Ophthalmology	1,065	1.8	25.5	3.9	55.9	24.9	7.7	5.1	3.8	1.3	1.1
Cardiology	837	1.4	41.9	6.1	45.4	24.7	9.3	8.1	7.8	2.6	2.1
Emergency medicine	782	1.3	31.1	4.6	51.8	24.2	9.3	5.6	5.8	2.4	1.0
Anatomical pathology	661	1.1	32.6	5.1	49.0	26.8	9.5	7.2	4.3	1.3	1.9
Neurology	636	1.1	40.8	6.2	44.9	25.7	9.8	9.0	6.1	2.2	2.3
Otolaryngology	589	1.0	31.1	4.9	50.1	27.6	8.7	5.9	4.1	2.0	1.6
Urology	572	1.0	28.4	4.9	50.0	28.4	9.0	6.1	4.1	1.2	1.2
Dermatology	499	0.8	38.9	4.8	50.5	22.2	8.6	8.3	5.6	2.6	2.2
Respiratory medicine	435	0.7	41.0	6.7	42.6	27.6	9.5	9.4	6.4	2.8	1.8
Plastic surgery	431	0.7	38.3	6.0	45.2	26.2	9.9	9.1	5.2	2.4	2.1
Community medicine	389	0.6	44.0	8.2	36.3	32.1	9.7	9.3	7.1	2.9	2.6
Gastroenterology	387	0.6	46.2	6.8	41.7	28.0	9.7	8.5	6.4	3.0	2.7
General pathology	365	0.6	35.9	6.1	44.9	27.3	10.3	7.8	6.2	1.9	1.7
Physical medicine	311	0.5	49.3	8.0	38.9	28.9	9.7	9.2	7.0	3.5	2.7
Endocrinology/Metabolism	295	0.5	59.9	9.3	36.2	26.8	10.2	9.9	8.5	4.1	4.3
Medical oncology	283	0.5	51.2	9.3	32.9	34.8	10.1	9.0	6.2	3.5	3.4
Cardiovascular/Thoracic surgery	282	0.5	55.7	11.0	30.2	33.9	10.3	9.7	8.8	3.4	3.7
Rheumatology	269	0.4	54.3	8.6	37.3	28.2	9.8	9.2	8.4	3.6	3.6
Nephrology	269	0.4	55.5	9.9	33.7	31.3	10.1	9.8	7.1	4.7	3.3
Radiation oncology	248	0.4	64.8	17.0	24.4	31.6	12.6	13.8	9.2	4.2	4.3
Medical microbiology	239	0.4	67.7	11.9	31.5	27.8	9.6	10.8	11.7	3.3	5.3
Haemotology	236	0.4	60.0	11.7	31.0	30.4	9.5	10.5	9.1	5.7	3.7
Neurosurgery	236	0.4	59.9	13.3	27.3	32.8	10.4	12.8	9.1	4.1	3.5
Nuclear medicine	210	0.3	47.5	9.4	34.4	32.8	10.4	9.2	7.4	2.6	3.1
Geriatric medicine	149	0.2	75.2	13.4	28.6	29.7	10.2	9.5	10.2	5.1	6.7
Infectious diseases	134	0.2	80.1	17.0	24.0	32.0	9.6	13.0	10.3	5.6	5.6
Clinical immunology	104	0.1	85.4	15.6	23.8	32.4	9.4	10.4	8.4	7.6	8.0
Medical biochemistry	94	0.1	113.3	28.7	20.1	28.7	9.1	11.5	10.4	8.3	11.9
Medical scientist $	68	0.1	108.9	30.2	16.7	29.4	11.0	13.6	10.7	8.5	10.1
Haematological pathology	52	0.0	107.7	24.5	16.6	33.7	9.2	11.1	11.1	7.6	10.7
Medical genetics	46	0.0	112.9	35.9	11.6	33.4	10.5	13.3	12.3	7.9	10.9
Therapeutic radiology $	44	0.0	112.2	27.1	14.8	33.4	11.9	13.0	10.2	5.0	11.7
Occupational medicine	40	0.0	142.0	27.8	16.4	32.1	10.4	11.4	8.6	3.9	17.2
Neuropathology	33	0.0	120.9	39.6	11.2	32.3	10.8	13.3	11.3	9.0	12.2

Source: 1999 Canadian Medical Association Physician Master File, 1996 Census
($) New category.
(+) In completed kilometres
(-) Nil or zero or amount too small to be expressed

Notes on 1999 modifications to Physician Master List:

1. Two new specialities namely therapeutic radiology and medical scientist were added to the list.
2. In addition some sub speciality categories were merged with the larger specialty grouping. For instance paediatric cardiology was merged with cardiology, vascular surgery and pediatric general surgery were added to general surgery, whereas public health was combined with community medicine. Also pathology/bacteriology was combined with general pathology. Cardio thoracic surgery and thoracic surgery were merged with cardiovascular/ thoracic surgery. Electroencephalography was combined with neurology and finally, physiatry was merged with physical medicine.
3. The mean and median distances for community medicine, pediatrics, cardiovascular/ thoracic surgery, neurology and physical medicine decreased due mainly to the additions of other sub categories to these groups.
4. The mean distance decreased while the median distance increased in cardiology, psychiatry, internal medicine, occupational medicine and plastic surgery.

Appendix G: Distance to Nearest Physician, By Medical Specialty, Canada, 1993

Specialty	Physicians	%	Distance to nearest Physician (KM)		% of population by distance (km) to nearest physician+						
			Mean	Median	<5	5-24	25-49	50-99	100-199	200-299	300+
All physicians	57,291	100.0	3.1	0.5	86.8	11.5	1.2	0.3	0.2	-	-
General practice/Family medicine	31,311	54.7	3.2	0.5	86.3	12.0	1.2	0.3	0.2	-	0.1
Psychiatry	3,415	6.0	20.3	2.2	65.8	18.1	6.2	5.2	3.2	0.8	0.8
Internal medicine	2,290	4.0	19.0	2.5	64.0	20.6	6.1	5.4	2.7	0.3	0.8
Anesthesia	2,230	3.9	23.1	2.4	64.8	17.8	6.1	6.1	3.1	1.1	1.0
Pediatrics	1,918	3.3	20.6	2.5	64.0	17.8	7.2	6.6	3.1	0.8	0.7
General surgery	1,804	3.1	13.4	2.3	67.2	21.5	5.5	3.8	1.4	0.4	0.4
Diagnostic radiology	1,760	3.1	19.4	2.6	63.9	19.4	7.0	5.7	2.8	0.6	0.6
Obstetrics/Gynecology	1,599	2.8	19.9	2.8	62.4	19.7	7.4	6.4	2.7	0.6	0.7
Ophthalmology	1,047	1.8	28.3	3.7	55.8	23.1	7.8	5.7	4.8	1.5	1.3
Orthopedic surgery	997	1.7	25.9	3.7	56.8	22.5	8.1	6.4	4.1	1.0	1.2
Cardiology	681	1.2	44.8	5.4	48.1	21.2	9.0	7.9	8.6	2.7	2.6
Otolaryngology	615	1.1	29.1	4.2	54.2	24.2	8.5	5.9	4.3	1.5	1.5
Anatomical pathology	572	1.0	31.0	4.9	50.2	25.1	10.2	7.3	4.6	1.4	1.4
Urology	559	1.0	28.4	4.5	52.7	25.3	9.0	6.1	4.6	1.1	1.2
Emergency medicine	482	0.8	52.5	6.8	43.0	26.7	8.7	7.2	6.3	3.9	4.3
Dermatology	464	0.8	44.9	5.3	48.6	22.5	8.6	8.0	6.1	2.9	3.2
Neurology	454	0.8	43.8	6.3	44.9	24.0	9.7	9.0	7.3	2.5	2.7
General pathology	439	0.8	35.5	5.0	49.9	23.2	8.9	7.5	7.2	1.9	1.4
Plastic surgery	392	0.7	41.7	5.8	45.8	23.9	9.9	9.7	5.4	3.0	2.3
Respiratory medicine	384	0.7	44.6	7.3	41.1	27.0	8.7	10.3	7.9	3.3	1.9
Gastroenterology	323	0.6	45.5	7.0	40.5	27.7	10.1	10.2	6.5	2.5	2.6
Community medicine	307	0.5	52.4	9.4	37.9	27.2	10.3	9.2	8.4	3.0	3.9
Radiation oncology	260	0.5	55.5	10.4	33.1	30.7	10.7	10.0	8.7	3.2	3.5
Haemotology	256	0.4	58.0	10.0	34.9	28.7	9.4	9.3	7.9	6.1	3.7
Endocrinology/Metabolism	233	0.4	66.3	13.4	32.8	26.3	10.8	11.8	9.1	4.0	5.1
Rheumatology	224	0.4	68.9	9.6	34.8	28.2	9.5	8.8	7.8	4.3	6.5
Medical microbiology	221	0.4	77.4	13.3	31.6	27.4	8.7	11.9	8.9	3.8	7.8
Physical medicine	203	0.4	52.1	9.5	33.8	31.4	10.9	8.8	7.9	4.5	2.7
Neurosurgery	197	0.3	52.8	11.4	30.5	30.8	11.2	12.1	8.9	3.9	2.6
Cardiovascular/Thoracic surgery	191	0.3	63.2	13.3	28.8	30.3	12.3	11.7	8.0	4.7	4.2
Nephrology	189	0.3	66.8	12.5	29.8	31.3	8.2	10.6	9.7	5.7	4.8
Nuclear medicine	177	0.3	55.3	9.8	34.4	30.1	10.0	9.6	8.7	3.6	3.7
Vascular surgery	128	0.2	52.4	9.6	32.8	33.9	8.8	10.7	6.9	3.6	3.3
Medical oncology	105	0.2	74.5	15.6	26.7	30.5	9.8	13.9	9.6	3.8	5.6
Electroencephalography	103	0.2	298.0	51.3	14.5	22.2	13.0	9.3	6.7	4.2	30.1
Geriatric medicine	96	0.2	99.2	24.1	24.0	26.5	11.0	12.4	9.5	5.1	11.5
Clinical immunology	89	0.2	112.0	22.4	22.3	29.2	10.0	10.6	8.3	4.6	15.0
Infectious diseases	84	0.1	86.1	22.5	19.5	32.2	11.8	11.9	10.4	6.0	8.0
Medical biochemistry	83	0.1	104.3	25.9	20.3	29.2	10.3	12.2	12.0	4.6	11.4
Public health	75	0.1	160.8	29.1	18.3	29.2	10.8	11.5	9.0	4.4	16.8
Thoracic surgery	67	0.1	85.5	19.2	21.9	31.6	9.8	13.7	12.5	3.9	8.5
Physiatry	65	0.1	860.1	169.3	12.0	10.4	4.6	7.0	24.8	6.6	34.7
Haematological pathology	59	0.1	110.4	28.0	18.5	29.7	10.1	10.0	11.6	8.0	12.2
Pediatric general surgery	48	0.1	89.0	27.7	15.4	32.6	11.7	13.3	12.7	6.7	7.7
Occupational medicine	42	0.1	145.7	27.0	18.7	30.3	9.8	11.0	8.5	3.4	18.2
Neuropathology	26	-	111.5	41.2	11.6	31.6	10.2	14.2	11.7	9.3	11.2
Pediatric cardiology	12	-	195.0	65.7	8.4	26.7	9.0	14.1	13.0	8.1	20.7
Medical genetics	11	-	164.0	62.1	8.1	29.5	9.3	14.6	10.7	7.3	20.4

Appendix G: continued, Canada, 1993

Specialty	Physicians	%	Distance to nearest Physician (KM) Mean	Median	% of population by distance (km) to nearest physician+ <5	5-24	25-49	50-99	100-199	200-299	300+
All physicians	57,291	100.0	3.1	0.5	86.8	11.5	1.2	0.3	0.2	-	-
Cardiothoracic surgery	3	-	992.9	280.6	2.9	12.0	3.8	8.5	19.3	4.6	49.0
Pathology/Bacteriology	1	-	1,132.0	548.7	0.5	7.1	8.0	6.4	5.2	2.1	70.8

Source: 1993 Canadian Medical Association Physician Master File, 1991 Census

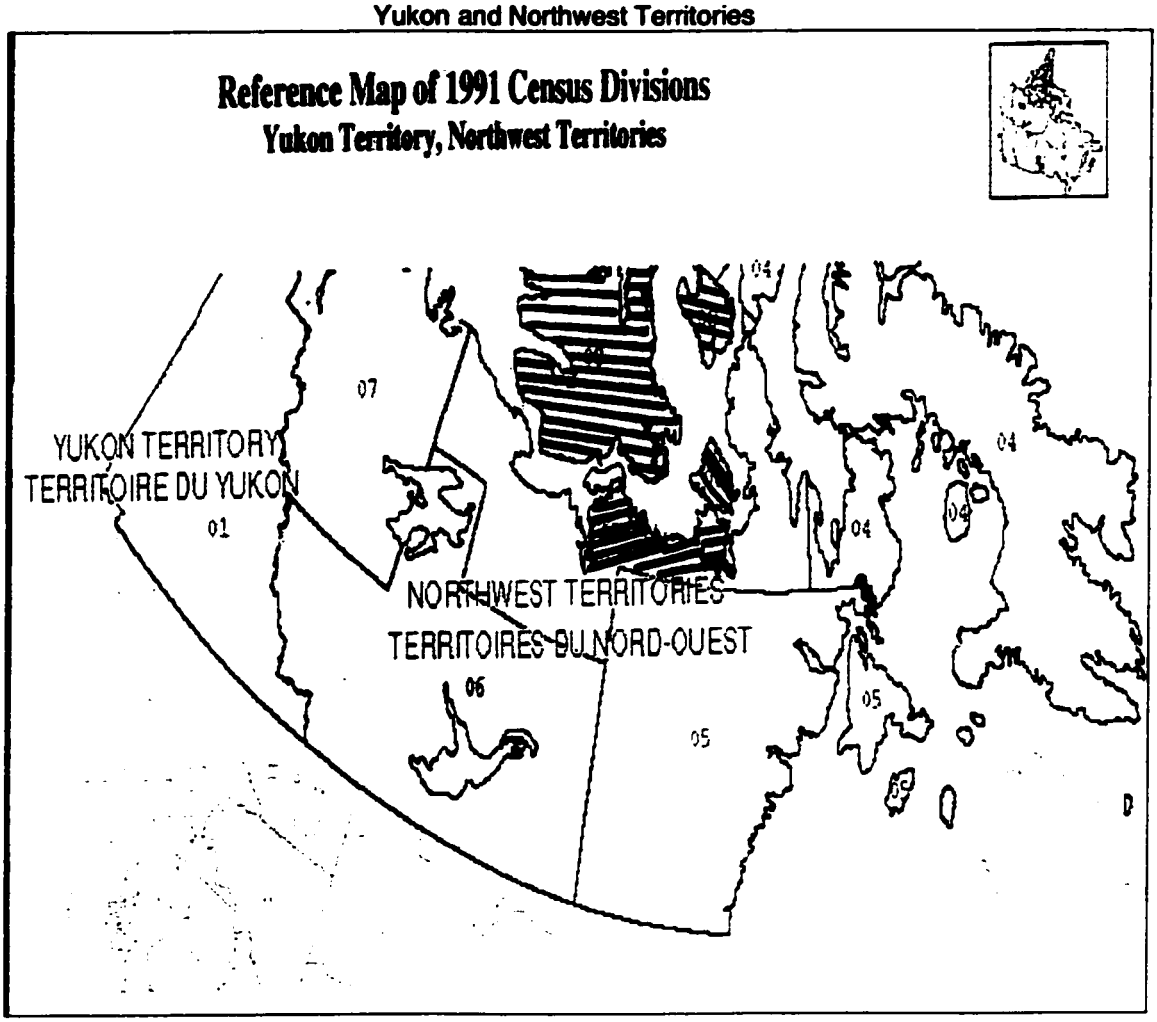
Appendix H: 1996 Standard Geographical Codes (SGC) of Provinces / Territories

Province/Territory	SGC Code	# of CDs	# of CDs >50,000 popn.
Newfoundland and Labrador (NF)	10	10	1
Prince Edward Island (PE)	11	3	1
Nova Scotia (NS)	12	18	3
New Brunswick (NB)	13	15	6
Quebec (QC)	24	99	30
Ontario (ON)	35	49	41
Manitoba (MB)	46	23	2
Saskatchewan (SK)	47	18	3
Alberta (AB)	48	19	10
British Columbia (BC)	59	28	15
Yukon Territory (YT)	60	1	0
Northwest Territories* (NT)	61	5	0

Notes:
* Includes Nunavut
# - number
Popn. - Population

Appendix I: 1991 Census Division (CD) Maps of Canada

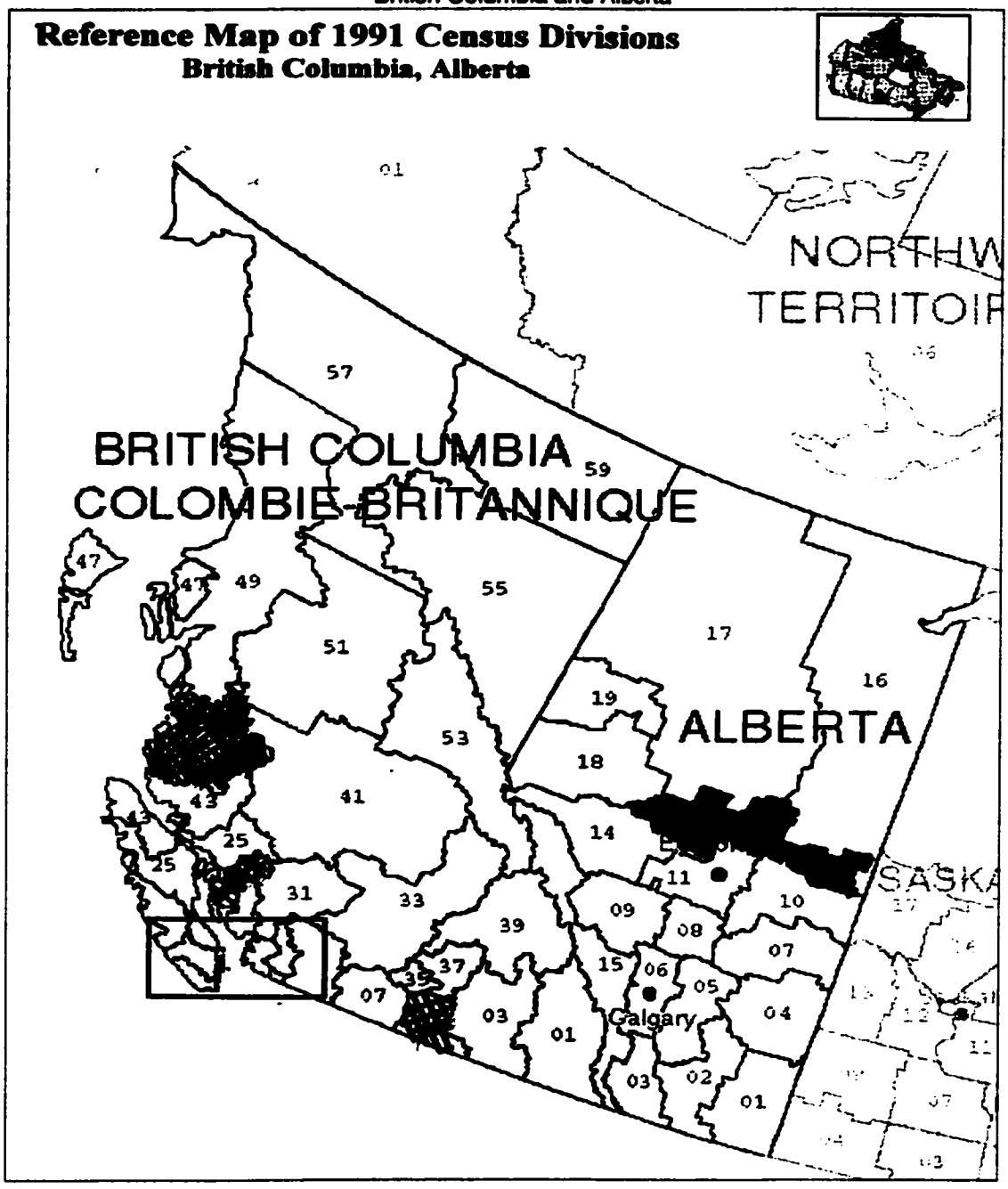
Yukon and Northwest Territories



Source: Health Canada, Cancer Surveillance On-Line website

Notes:
- 1991 Reference maps were used because labelling of CDs more legible than 1996 maps
- Hatched area refers to "worst-served" rural CDs

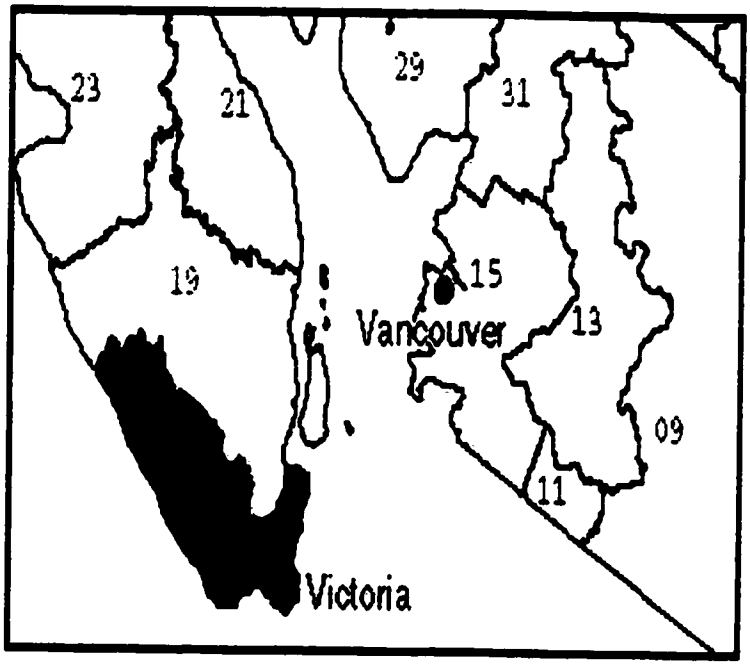
British Columbia and Alberta



Source: Health Canada, Cancer Surveillance On-Line website

Notes:
- 1991 Reference maps were used because labelling of CDs more legible than 1996 maps
- Grey areas represents "worst-served" urban CDs
- Cross hatched area refers to "best-served" rural CDs

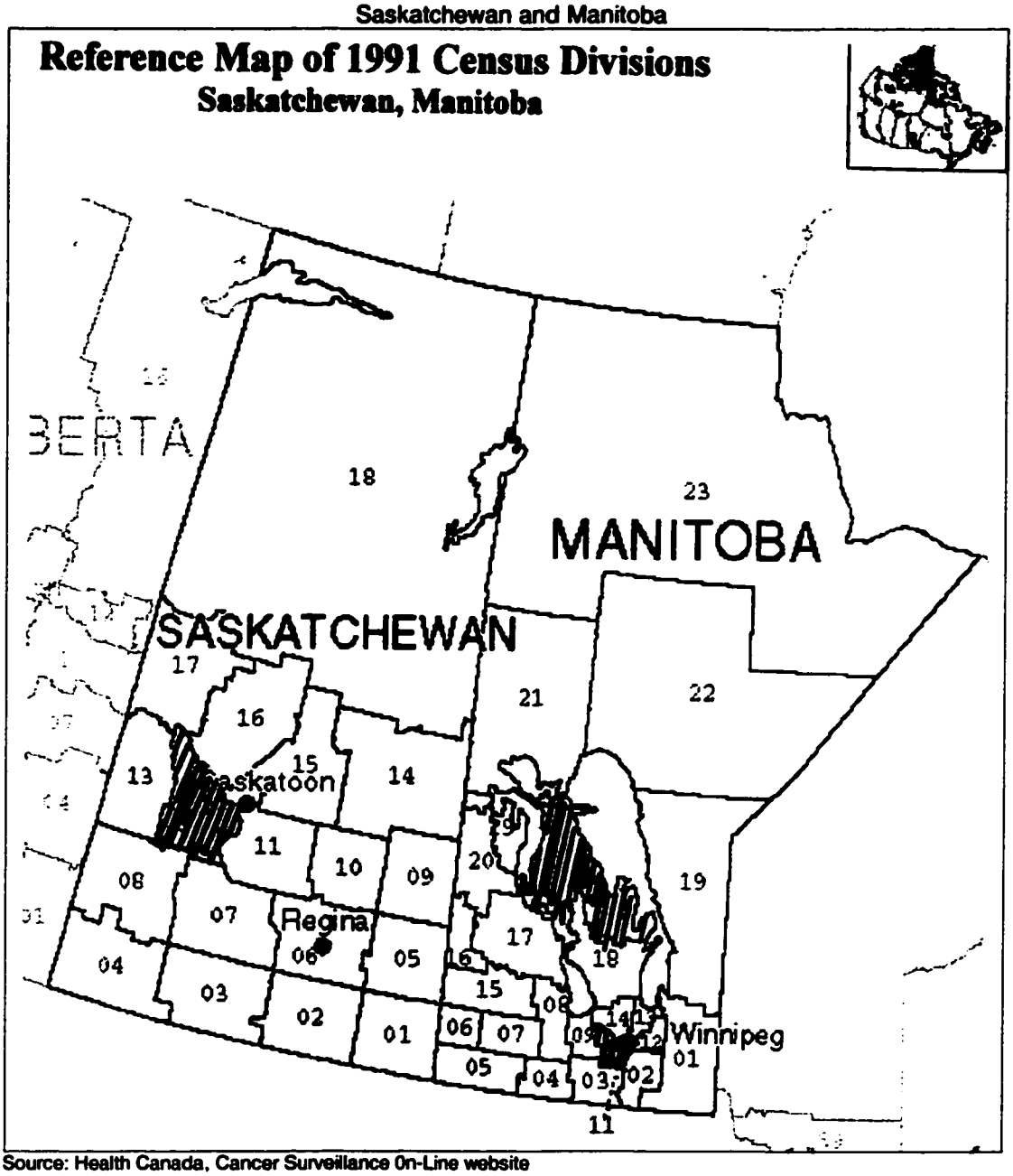
Reference Map of 1991 Census Divisions
Southwest British Columbia



Source: Health Canada, Cancer Surveillance On-Line website

Notes:
- 1991 Reference maps were used because labelling of CDs more legible than 1996 maps
- Dark area represents "best-served" urban CDs

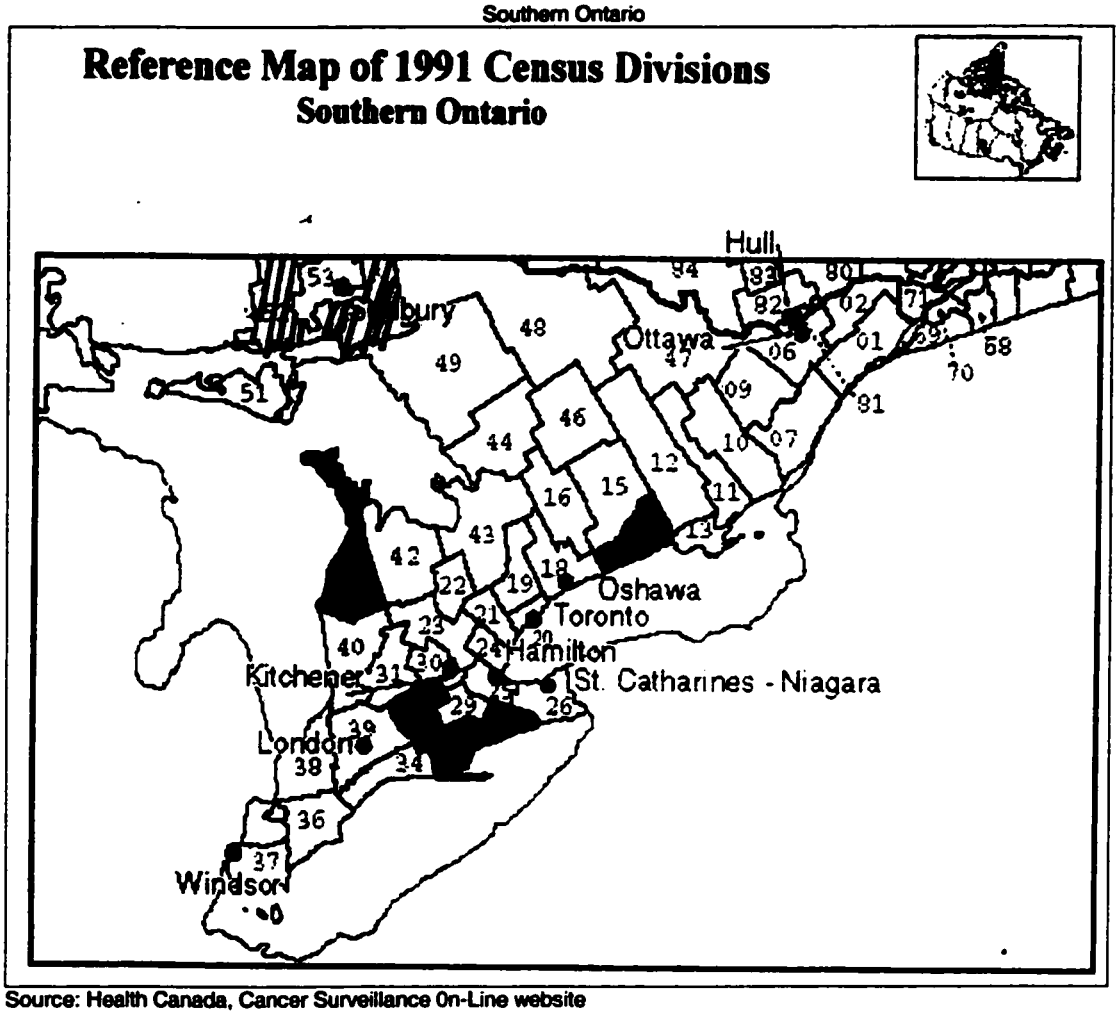
Saskatchewan and Manitoba



Source: Health Canada, Cancer Surveillance On-Line website

Notes:
- 1991 Reference maps were used because labelling of CDs more legible than 1996 maps
- Hatched area represents "worst-served" rural CDs

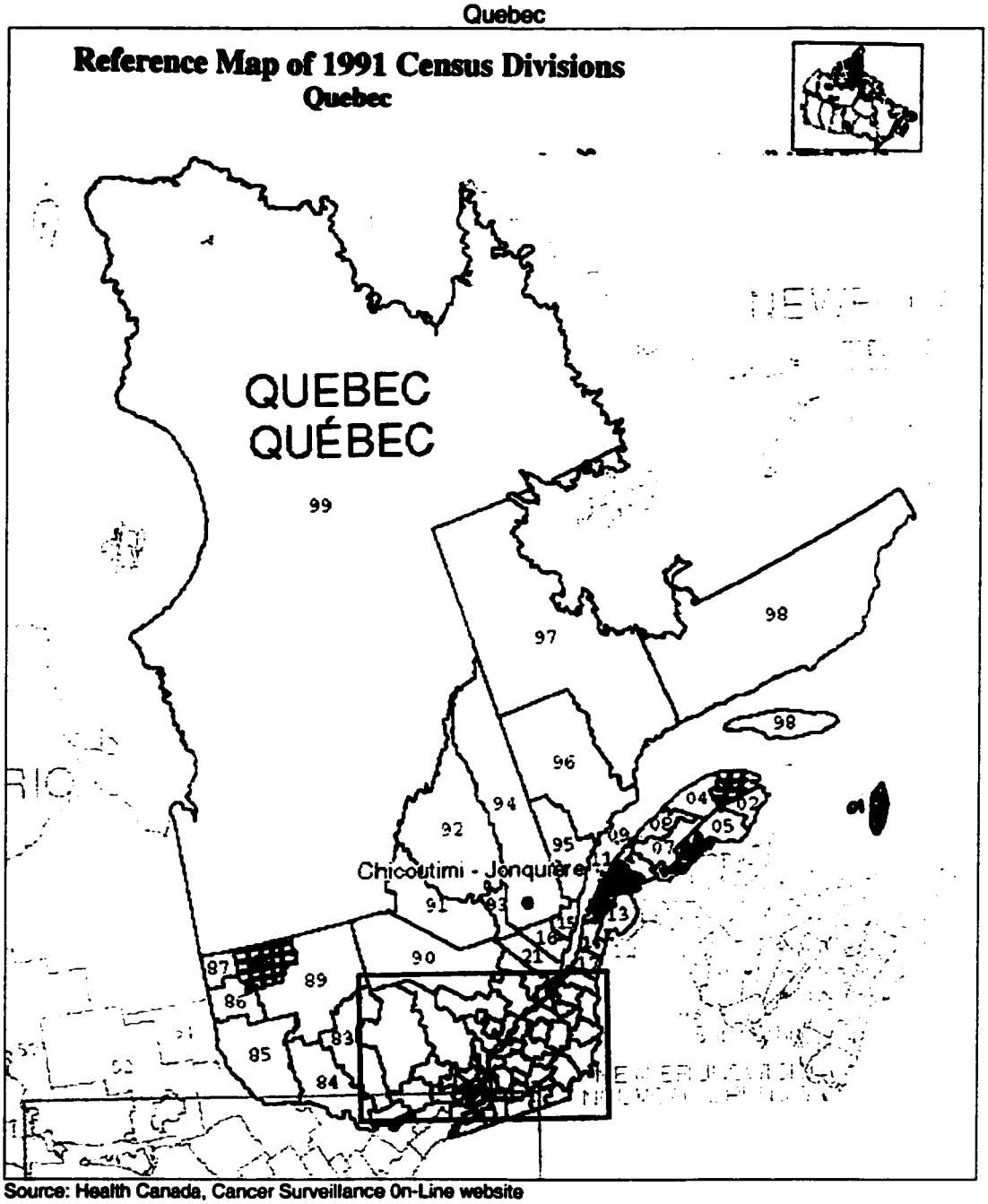
Southern Ontario



Source: Health Canada, Cancer Surveillance On-Line website

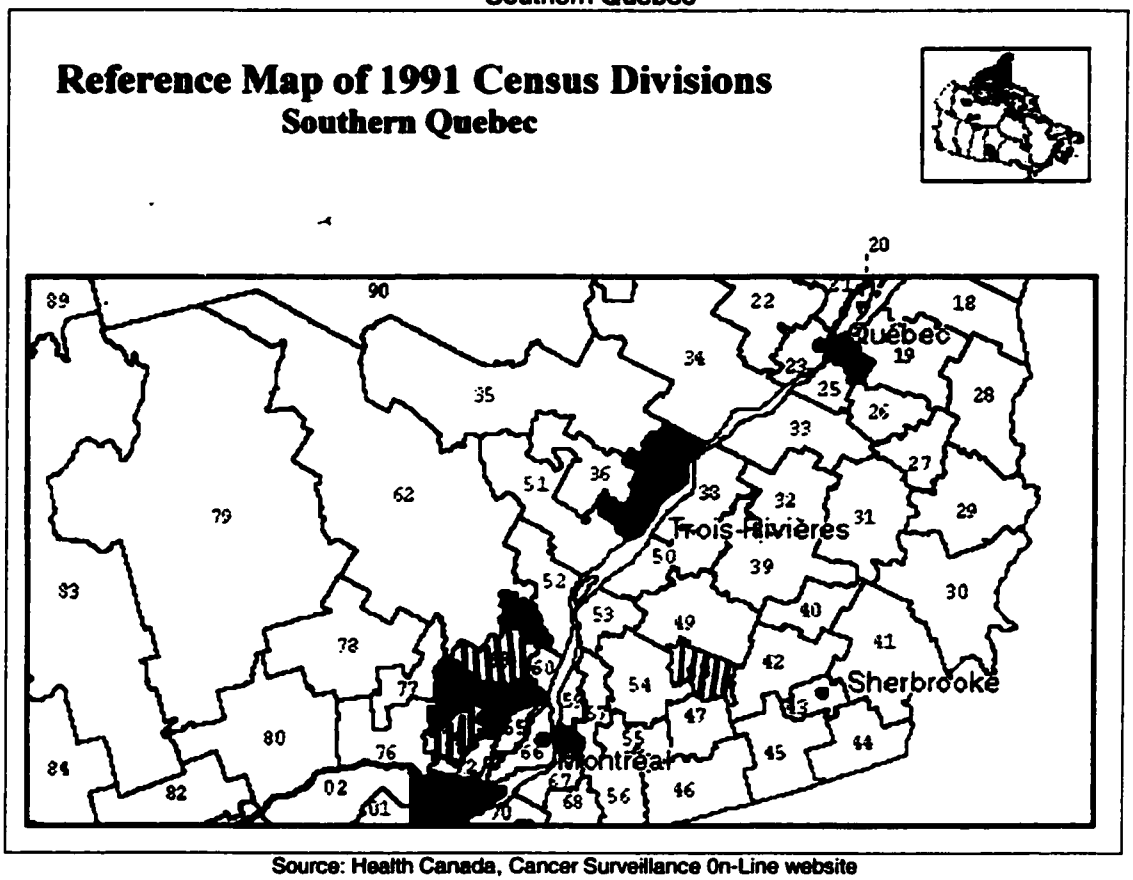
Notes:
- 1991 Reference maps were used because labelling of CDs more legible than 1996 maps
- Hatched area represents "worst-served" rural CDs
- Grey areas represents "worst-served" urban CDs

Quebec



Source: Health Canada, Cancer Surveillance On-Line website

Notes:
- 1991 Reference maps were used because labelling of CDs more legible than 1996 maps
- Dark area represents "best-served" urban CDs
- Cross Hatched area refers to "best-served" rural CDs



Source: Health Canada, Cancer Surveillance On-Line website

Notes:
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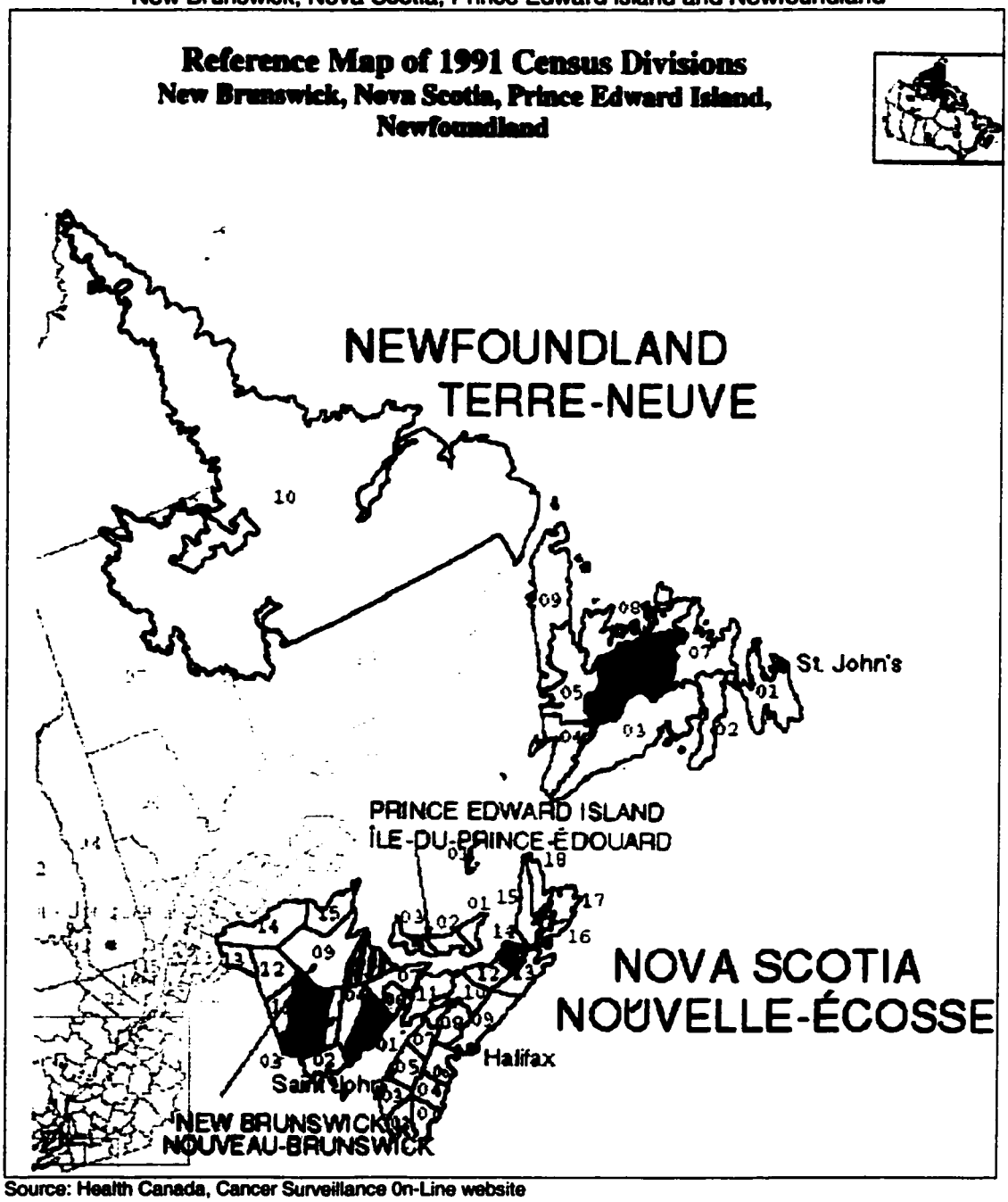
- Dark area represents "best-served" urban CDs
- Hatched area represents "worst-served" rural CDs
- Grey area represents "worst-served" urban CDs

New Brunswick, Nova Scotia, Prince Edward Island and Newfoundland



Source: Health Canada, Cancer Surveillance On-Line website

Notes:
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- Grey area represents "worst-served" urban CDs
- Cross hatched refers to "best-served" rural CDs
- Hatched area refers to "worst-served" rural CDs