UNIVERSITY OF CALGARY

Geography and Access to Health Services: A Multimethod Exploration of a Centralized Preoperative Assessment Clinic

by

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A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE

DEGREE OF DOCTOR OF PHILOSOPHY

DEPARTMENT OF COMMUNITY HEALTH SCIENCES

CALGARY, ALBERTA

NOVEMER, 2006

UNIVERSITY OF CALGARY

FACULTY OF GRADUATE STUDIES

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a dissertation entitled "Geography and Access to Health Services: A Multimethod Exploration of a Centralized Preoperative Assessment Clinic" submitted by Judy Seidel in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

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ABSTRACT

Health services research is a broad and complex field of inquiry that has undergone rapid growth because of increasing interest and concerns regarding escalating health system costs, access to services, and quality of care. Given the complexity of issues examined in health services research, the creation of new knowledge requires inputs from a broad range of academic disciplines and application of multiple research methods.

The overall objective of this thesis was to explore the application of multiple methods and interdisciplinarity to study a complex health services research question, that being geographical access to a centralized preoperative assessment clinic. Despite the potential for cost savings resulting from economies of scale and potentially higher quality of care, the centralization of health services may decrease access to many health services. The preoperative assessment clinic served as a case study in this thesis. These clinics provide an important clinical service (i.e. clinical evaluation of patients in advance of their surgery) and have demonstrated benefits for both patients and the health care system.

Three substudies were conducted to explore geographical access to a preoperative assessment clinic located at a tertiary health care centre. The first study employed a classical epidemiological and biostatistical approach (i.e., multivariate modeling) to examine preoperative assessment clinic utilization based on a patient's place of residence and the likelihood of a patient visit to the clinic prior to surgery. This study demonstrated that patients were less likely to attend the preoperative assessment clinic prior to surgery as distance from the clinic increased known as a distance decay effect. For example, patients who lived 50 km to 100 km from the clinic had approximately half the odds of being seen in the preoperative assessment clinic than did patients who lived closer, while patients who lived furthest from the clinic had approximately one-quarter the odds of being seen.

In the second substudy, a geographic information system (GIS) was used to explore the spatial aspects of patient location and preoperative assessment clinic utilization. Maps were constructed to explore spatial patterns and cartographic visualization principles guided the analyses. This study confirmed the same distance decay pattern

observed in the first study but provided a powerful visualization of the phenomenon in greater detail and in a form that could quickly and easily be interpreted by a wide range of stakeholders. Further, it added new information such as revealing non-uniform utilization patterns within distance bands.

The third substudy explored geographical access by focusing on one of the key stakeholders in the referral decision-making process (i.e., the surgeon). A survey instrument was developed using input gathered through interviews with surgeons. This was followed by a survey of the surgeon population at a tertiary care centre to examine whether patient location factors were considered in their referral decision-making process. This study showed that surgeons consider patient location factors when deciding whether to refer their patient to the preoperative assessment clinic. However, patient location factors were considered less important than patient medical or health system factors in the decision-making process.

The studies presented in this thesis exemplify the merit of multiple methods and interdisciplinary evaluations in health services research. Interdisciplinary is a powerful paradigm that facilitates the generation of comprehensive knowledge required to address many of the complex issues faced in health services today.

ACKNOWLEDGEMENTS

First, I would like to thank the Calgary Health Region for their support through the Advanced Degree Award Program, thus making this PhD a reality. Second, I would like to thank my colleagues at the Centre for Advancement of Health for their never ending support throughout the course of my studies. A special thanks to Elizabeth MacKay for her leadership, friendship, laughs, and for keeping me sane while “Rome was burning”!

I am extremely grateful to my thesis committee, first for accepting me as one of their flock of students, and second for their direction, open mindedness and wisdom. In particular, I would like to thank Bill Ghali for keeping me grounded, focused, and sticking with me while life was presenting its many challenges. I would also like to thank him for his mentorship, encouragement, immeasurable positive attitude and always pushing for the highest standards -- an amazing educator. I am grateful to Nigel Waters for making interdisciplinarity and geography a wonderful and fun experience, for his endless positive and encouraging guidance, and of course for sharing his incredible breadth of knowledge. And last but certainly not least, many thanks to Lloyd Sutherland who has been an invaluable mentor over the past 10 years, for his unremitting support of my ventures, and of course for his enlightening ideas that are always five degrees off centre!

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES AND ILLUSTRATIONS

LIST OF ACRONYMS

CABG – Coronary Artery Bypass Grafting

CHR – Calgary Health Region

CIHR – Canadian Institutes of Health Research

GIS – Geographic Information System

MAUP – Modifiable Area Unit Problem

PAC – Preoperative Assessment Clinic

TDM – Total Design Method

GEOGRAPHY AND ACCESS TO HEALTH SERVICES: A MULTIMETHOD EXPLORATION OF A CENTRALIZED PREOPERATIVE ASSESSMENT CLINIC

CHAPTER 1

THESIS OVERVIEW

Title: Geography and Access to Health Services: A multimethod exploration of a centralized preoperative assessment clinic

1.0 THESIS OVERVIEW

Health Services Research in Context

The growing interest and concerns regarding escalating health system costs, access to services, and quality of care (e.g., effectiveness, efficacy, and appropriateness of service), has led to rapid growth in health services research. Health services research is a broad field of inquiry with the aim of improving health services and ultimately the health of the population (1). It is an applied research field that focuses on practical issues in the real-world setting. The most often referred to definition for health services research comes from the Academy for Health Service Research and Health Policy. They define health services research as:

> - a multidisciplinary field of scientific investigation that studies how social factors, financing systems, organizational structures and processes, health technologies and personal behaviors affect access to health care, the families, organizations, institution, communities and populations (2).

Simply put, health services research is the study of how to make health care more effective, more equitable, and more efficient (1). Hence, this field of inquiry explores complex processes, structures and outcomes of health care. Given these complexities, multiple approaches and methods are required to investigate problems and provide practical information to health care decision- and policy-makers.

Epidemiology provides the conceptual foundation for much of health services research. However, scientific inquiry in this field relies on inputs (i.e. concepts, theories, devices, data, instruments, and knowledge) from many different disciplines including but not limited to medicine, nursing, statistics, social sciences, ethics, economics, commerce, computer science, and engineering.

The multidisciplinary nature of health services research lends itself to the incorporation of multiple methods. Despite this ‘natural’ fit, multimethods research in health service research is relatively new, albeit a widely accepted approach to study complex health service issues (1). An extension to the use of multimethods is the incorporation of interdisciplinarity, where different disciplines work together on the same problem as opposed to different disciplines working separately on a broader aspect of the problem, as is the case with multidisciplinarity.

Multiple methods and interdisciplinary research are beneficial for exploring issues in health care. The reported benefits include the production of more accessible and applicable knowledge for all stakeholders including decision-makers and the public. Essentially, multiple methods and interdisciplinarity complement and inform each other, providing information on various components of the same phenomenon.

This thesis explores the application of multiple methods and interdisciplinarity to study geographical access to a centralized health service, namely a preoperative assessment clinic. Geographical access to health services is of concern given the move toward the centralization of many health services since the 1990s. Despite the potential for cost savings resulting from economies of scale and potentially higher quality of care, the centralization of health services may decrease access to and utilization of many health services (3). In Canada, the trend toward centralization takes on further concern because of the geographic vastness of this country and a universal health care system that strives to achieve equitable access for all Canadians, including those in sparsely settled rural areas. It is estimated that over 6 million Canadians live in rural or remote regions (4).

Thesis Overview

This thesis begins with a review of the pertinent background literature on geography and access to health services. Specifically, the following areas are discussed in the literature review: geography and health, utilization of health services, distance as a proxy measure of access, and a brief description of the preoperative assessment clinic, which serves as the centralized health service examined in the present study. These four topic areas encompass the principal concepts, conceptual models and previous works that underlie the present study. The background section is followed by three interrelated studies on patient access to a regional preoperative assessment clinic in a Canadian tertiary care centre.

The first study employed a classical epidemiological approach to examine preoperative assessment clinic utilization, one component of the access concept. Multivariate modeling was used to assess the association between geographical distance from a patient's place of residence to the preoperative assessment clinic, and the likelihood of a patient visit to the clinic prior to surgery. In the second study, a geographic information system (GIS) was used to explore geography and patient access to the preoperative assessment clinic. Maps were constructed to explore spatial patterns in the data and the principles of cartographic visualization were used to guide the analyses. The third interrelated study probes further into the utilization phenomenon by focusing on one of the key stakeholders in the referral decision-making process (i.e. the surgeon). Interviews with several surgeons were conducted to develop a survey instrument. This was followed by a survey of the surgeon population to explore whether patient location factors were considered important in their referral decision-making process.

Finally, the findings of the three interrelated studies are summarized and the merits of applying a multimethods interdisciplinary research approach to study the complexities of geographical access to a centralized health care service are discussed.

CHAPTER 2

GLOBAL STATEMENT OF THE THESIS PURPOSE

2.0 GLOBAL STATEMENT OF THE THESIS PURPOSE

2.1 Study Rationale

Many different disciplines conduct research on access to health services. Within these disciplines, different methodological approaches are often used because of the techniques, principles, theories, and approaches that have been adopted within each discipline over time. Each method has strengths and limitations, and no one approach is necessarily the best. It is believed that multiple methods and interdisciplinary research will enhance our understanding of the issues by enriching the depth and breadth of study (1). Despite this belief, there appears to be a gap in the literature regarding studies that have taken a multimethod interdisciplinary approach to address a single healthcare issue. This approach is well suited to a study of geographical access to preoperative assessment clinics, particularly given the paucity of information on access to this clinic and its related referral processes. Further, since these services are located in large urban areas (i.e. centralized), numerous geographic factors such as travel distance, travel time, and mobility are likely to become increasingly important determinants in a patient's ability to access this service.

2.2 Study Objectives

The overriding goal of this project is to explore patient utilization of a centralized preoperative assessment clinic located in a tertiary hospital, using three different research methods. The present study focuses on the geographical location of patients while considering other possible explanatory factors such as patient clinical characteristics and surgeon referral decision-making. This thesis has three general objectives:

1) To employ classical epidemiological and biostatistical methods approach to study the relationship between geographical distance from a patient's residence to the preoperative assessment clinic and the likelihood of attending the clinic (Study I).

2) To use cartographic visualization and mapping methods to examine the spatial relationship between geographical distance from a patient's residence to the preoperative assessment clinic and patient utilization of the clinic (Study II).

3) To use interview and survey methods to explore surgeon decision-making as it relates to patient location and referral of patients to the preoperative clinic prior to their surgery (Study III).

The combination of study objectives for this thesis and the ensuing studies produce an informative body of information that exemplifies the merits of multi-method evaluations in health services research.

CHAPTER 3

GLOBAL INTRODUCTION

3.0 GLOBAL INTRODUCTION

3.1 Geography, Health Services, and Access

Geography and access to quality health care are two well recognized determinants of health (5). Attention to these determinants and specifically geographical access to health care has increased over the past decade or so for several reasons. The development of a population-based framework for understanding the determinants of health led to an expanded concept of health that extends beyond the biomedical model (5). More recently the centralization of many health services was instituted as a means of achieving economies of scale in the face of fiscal constraints and health system sustainability. Additionally, the goal of achieving the highest quality of care through greater subspecialization was viewed to be equally important (6). Emphasis on access and geography can also be noted in the First Ministers' meeting and the resultant 2003 Accord on Health Care Renewal. This document outlines the governments' commitment to ensure that "all Canadians have timely access to health services on the basis of need, not ability to pay, regardless of where they live or move in Canada" (7). Given that 20% of the Canadian population lives in rural or remote areas, we can expect that over 6 million Canadians may have difficultly accessing centralized health services based on location alone (4).

The components and concepts of geography and access to health services are numerous and complex. For this reason the following discussion is limited to four major subtopics. A brief description of the concept of access is provided, followed by a discussion on health services utilization, distance as an indicator of geographical access, and a description of a conceptual model applied to the study of health services. This chapter concludes with a brief description of the preoperative assessment clinic.

3.2 Access to Health Services

Access to health care is a complex concept that has undergone significant development over time. In a general sense, access can be thought of as operating at a personal level at one end of the spectrum, to operating at the health care system level at the other end, with a host of factors that interact along the continuum. There is extensive literature on the definition and conceptualization of access. Perhaps the most comprehensive account is provided by Gulliford et al (8), who examined the literature on access and provided an overview of the most current conceptualization of this term. In addition, a recent report by Torgerson et al (9) comments on the work presented by Gulliford and outlines a preliminary framework for understanding factors that influence Canadian's ability to access health services. Gulliford's paper is briefly summarized below.

Gulliford et al (8) suggests that access to health care is comprised of at least four dimensions: (a) *service availability*, (b) *utilization of services and barriers to access*, (c) *relevance and effectiveness*, and (d) *equity*. Although not specifically highlighted in the above categories, Goddard and Smith (10) suggest that quality of service (i.e. structure, process, and outcome) can be considered a fundamental element of access because quality complicates the assessment of the dimensions of access.

The components of *service availability* and *utilization* were put forth by Aday and Anderson in 1975 (11) using the terms 'potential access' and 'realized access'. Essentially, *service availability* (potential access) refers to the opportunity to access health care when it is wanted or needed, and focuses on the resource requirements and the allocation of these across geographic areas. From an economic perspective, *service availability* refers to the supply side of the supply-demand concept. Of note, availability of appropriate service contains a geographic component (e.g., What is reasonable given the dispersion of the population in Canada?) (8). However, what constitutes 'reasonable' depends on different population groups (e.g., socio-economic groups). Several indicators commonly used to measure *service availability* include the number of physicians and hospital beds per capita, or costs to an individual (e.g., cost of travel and inconvenience to obtain the service). Proximity to service (i.e. distance and time) also is used as an indicator of service availability.

Utilization and barriers to access (realized or actual access) refers to services that are available but patients may have difficulty utilizing these services for various reasons including personal, financial and organizational barriers. Pechansky and Thomas (12) suggest that personal barriers involve individuals' perceptions, attitudes, beliefs and previous experience with health care. Financial barriers are typically dependant on socio-economic factors such as ability and willingness to pay (e.g., costs associated with travel, lodging, health service fees, lost wages, and inconvenience). Organizational barriers involve systematic factors embedded in the health care system that affect delivery components such as wait times and wait lists. In this sense, access is mediated by availability, spatial accessibility (geographic or spatial availability of providers), accommodation (meet the needs of patients), and affordability (9). Gatekeeping and physician referrals also are recognized as mediating factors in the utilization of health services (8). For example, the ease in which a patient can access certain services can depend on the appropriateness of referrals (e.g., access to the preoperative assessment clinic is through a surgeon referral process). Utilization is discussed further in the next section of this chapter.

Rogers et al (13) describes the *relevance and effectiveness* components of access as 'the right service at the right time in the right place'. These components are typically measured using clinical outcomes or indicators of health status. Finally, *equity* captures the notion of fairness and social justice, and often is referred to as equal access to health services for people in equal need. Although there are various notions of equity, the above definition does not involve ethical judgment. *Equity* is considered the most difficult dimension to measure.

3.1.2 Geographical Access

As described above, there are both spatial and nonspatial factors that affect access. The geographic or spatial aspects of access to health services are extensive and interact with nonspatial factors. Typically, access from a geographic perspective focuses on the aspects of availability of a health care service such as distance traveled and the location of patients relative to the location of the health service (14). In this regard, geographical accessibility is defined as a function of location, time, and distance (15). Research suggests that utilization and access of health services are dependent on where the patient lives relative to the location of the health service (geographical access) (15-17). Measures of distance are often used to explore access to services.

The regionalization or centralization of health services, which is a characteristic of the health care system, is considered another important spatial factor in access to health services. In a geographic sense, regionalization refers to the allocation of service delivery or utilization based on geography (14,16). However, in recent years, regionalization has focused on the rationalization of service delivery with the goal of improving access and responsiveness to health needs, lowering cost while increasing quality, and increasing equity (14-16). Regionalization plays an important role in the equitable access of health services and in many cases acts as a barrier to utilization as more and more services are centralized. Further, Posnett (6) suggests that there is a paucity of evidence in the literature that indicates the achievement of the goals of regionalization (i.e. cost, quality, and access).

3.3 Utilization of Health Services

Health care utilization may be defined in terms of the category and purpose of the health service that is provided or desired (16,18). Categories of health services include physicians, other health professionals, health care facilities, as well as pharmaceutical and medical devices. These health services are further classified into three levels of service or health care provision, each with specific goals (16,18):

(1) primary – to reduce or prevent the onset of health problems in healthy persons. This activity typically occurs at home, or in a clinic, or health care centre.

(2) secondary – to reduce mortality and morbidity through early detection of disease and intervention that alters the course of disease. Specialized services are usually offered in a hospital setting, often at the local level. The typical route for access is through the primary care physician.

(3) tertiary – to reduce mortality and morbidity in individuals with existing disease. More highly specialized services that are not available in the smaller hospitals. Tertiary hospitals are located in centralized locations and access is through primary and secondary health services referral mechanism.

Numerous factors affect the utilization of health services. First, utilization is need driven, although research has shown that utilization tends to vary with need (15,16,18). Sociodemographic and socioeconomic characteristics of a population, as well as the beliefs, knowledge and attitudes about health service and disease also affect utilization. For example, studies have shown that utilization at the primary level tends to be higher in women, children, the elderly, as well as individuals who perceive their health to be poor

(15-16,18). However, utilization in these and other groups are further impacted by characteristics of the health care system and availability of health services. Research has demonstrated geographic disparity in the availability and provision of many health services, often resulting in wide variations in utilization by geographic region (16,18). Several models have been developed to explain and predict access to and utilization of health care services. One such model, the *Model of Health Services Utilization* by Anderson and Aday, is presented in the next section (19).

3.4 Health Services Utilization - Conceptual Model

Numerous studies have demonstrated that the utilization of health services varies across geographic areas, across and within medical specialties, and across health systems [16,17,20-23]. It is proposed by some that the observed variation is largely the result of physician decision-making, and that patient, health system, and personal/professional factors influence these decisions (19).

The most commonly applied model to explain and analyze factors associated with utilization of health services is the conceptual model developed by Anderson and Aday known as the *Model of Health Services Utilization* (also called the *Behavioral Framework for Health Services Utilization*) (19,24-26). The major purpose of this framework is to reveal conditions that either facilitate or impede utilization such as identifying the 'hows' and 'whys' of health service utilization (19). While this framework has undergone several revisions since it was initially proposed in 1960, it maintains a systems perspective, whereby population characteristics, environment, and health behavior factors are recognized as the primary determinants of health service utilization behavior (see Figure 3.0).

The *environment* domain is comprised of factors such as the healthcare delivery system, the external environment, and community variables. *Population characteristics* are comprised of predisposing, enabling (impeding), and need-based factors. These include:

- *Predisposing factors* – sociodemographic variables (age, sex, ethnicity, marital status, education, occupation, religion, residential mobility, past illness), health values, and beliefs (e.g., values concerning health and illness, attitudes toward health services, knowledge about disease).

- *Enabling factors (or impeding)* – the means available to someone that enables use of health services such as financial resources, medical insurance, cost of service, physical access to care, travel for service, regular source of health care, social and family structure, region of the country/province, and urban-rural characteristics.
- *Medical need* – includes both perceived and evaluated factors such as disability, symptoms, diagnoses, severity of illness, general health status, health perceptions, disability days, and days of restricted activity.

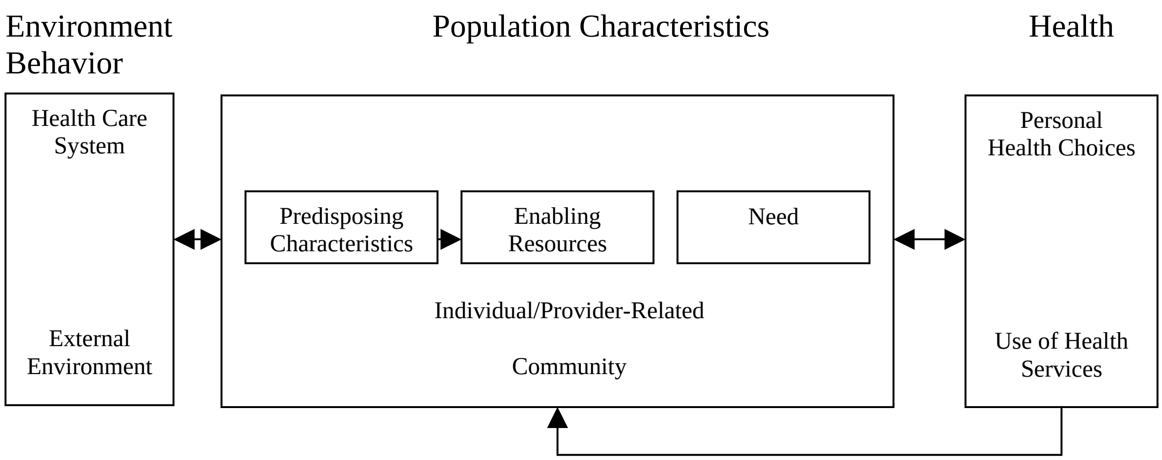


Figure 3.0 Health services utilization model. Adapted from KA Phillips et al. (19)

Finally, the *health behavior* domain addresses both personal health practices and current use of health services.

Provider-related factors were included in the later versions of this model after recognition that these factors constituted a critical component of the health services utilization model (19). This component captures provider factors that interact with both patient characteristics and healthcare system factors such as physician gender, medical specialty, and perceptions about the health service, the healthcare system, and the patient. Provider-related variables play a major role in influencing the type, timing, and level of service provided (19). Given today's trend toward the shared decision-making concept in the physician-patient encounter, further examination of the interactions between physicians (providers) and patients is important for understanding the utilization of health care services.

3.5 Distance as a Measure of Geographical access

Distance is a multifaceted concept that relates one place (location in space) to another, and is recognized as an important factor in access to health services (15,17,21). Typically, distance is referred to as a measure of physical distance separating one location from another on the earth's surface (14). However, the concept of distance is more complex. Measures of distance include: (a) linear distance, (b) road distance, (c) travel time, (d) travel cost, (e) perceived distance, (f) perceived travel time, and (g) mobility (e.g., availability of transportation mechanisms). Other measures of distance that are not spatial, but are important factors of accessibility include social and economic distance (14,16).

Research demonstrates that distance can act as a barrier to access health services (14,16-17). Often, utilization of health services decreases as distance from a patient's place of residence to the service increases. This inverse relationship is referred to as the 'distance decay' effect (15-16). Several studies have examined geographical access to medical services, such as cardiac procedures (27-30), cancer treatment (31-32), mammography (33), hospital discharge (34), and medical surgical care (35). A decrease in the utilization of these medical services was observed for patients living further distances from the service. The observed reduction persisted after controlling for other explanatory variables such as age, sex, and income. It has also been demonstrated that distance decay impacts the utilization of health services for specific age groups such as children and elderly. Kelly (36) observed that mortality due to post acute neonatal causes was lower in infants who lived closest to the hospital. Nemet and Bailey (37) demonstrated that the utilization of primary care physicians by elderly patients decreased substantially as locational distance between the patient and physician increased. Conversely, other studies observed that distance was not a factor in the utilization of highly specialized services such as invasive cardiac procedures (38-40).

It is believed that distance decay is a consequence of numerous factors including additional time, cost, and effort required to travel longer distances (22). Further, this phenomenon is affected by demographic and socioeconomic characteristics such as age, race, gender, income, education, and occupation (14-17). Gatrell (16) suggests that people differ in their ability to overcome distance constraints, whether the constraints are real or perceived. Further, people are more likely to act on perceived as opposed to actual distance regardless of whether distance is measured as time or mileage (14).

Several theories and principles have been put forth to explain the distance decay phenomenon. Christaller's central place theory consists of two basic concepts: threshold and range. Threshold refers to the minimum population that is required to bring about the provision of certain goods or services (14,21,41). Range is the average minimum distance that people will travel to buy or consume these goods or services (14,21,41). According to the Christaller's central place theory, consumers will travel only as far as necessary to obtain a desired good or service (14,21,41). This concept provides the basis for two underlying principles. First, consumers or patients tend to select the shortest path. This is the principle of least effort. Second, the principle of friction distance states that consumers or patients will travel different distances depending on the perceived level of service they will receive, and the importance of that service to the individual (14,16). Research has demonstrated that distance can act as a barrier depending on whether the patient perceives the service to be a convenience good (e.g., routine medical care), or a specialty good (e.g., coronary artery bypass graft - CABG). From the consumer's perspective, tradeoffs are often made between the 'cost' of accessing the service versus the 'benefits' received by the individual. This same principle also applies to physician willingness to refer a patient to a particular service (14).

Of note, there is a distance beyond which a consumer is willing or able to travel (14,16). For example, Howell (42) examined whether patients would sooner wait one year or more for elective surgery at a local hospital, or alternatively travel 120 miles from their home for surgery at an earlier time. The health region supplied all costs and means of travel. Approximately one-half of the patients agreed to travel for their surgery. After returning home post-surgery, patients were asked about their willingness to travel for routine surgery. A distance of 50 miles was acceptable to 90% of survey respondents, while 300 miles was acceptable to 66%. Further, when asked how long they would be willing to wait for surgery before traveling, 40% would wait only 1 month, 91% would wait no longer than one year, and all patients would sooner travel than wait 2 years. This observation aligns with other studies that have demonstrated that health care consumers will travel further the more specialized the service, the more urgent or acute the event, and the more sophisticated the patient perceives the service to be (14,16).

3.6 Preoperative Assessment Clinic

The preoperative assessment clinic (also referred to as a preadmission clinic) is a regionalized and centralized health service that is the focus of this thesis. The major purpose of the preoperative assessment clinic is to provide a clinical evaluation of patients in advance of their elective surgery. Preoperative assessment clinics were introduced into Canada over one decade ago to reduce costs, increase efficiency, and implement a formalized preadmission process to optimize patient care (43-44). Patients typically are seen 1 to 2 weeks in advance of their surgery to undergo appropriate clinical investigations by a multidisciplinary team of health professional (e.g., internists, anesthesiologists, cardiologists, nurse specialists), thus eliminating the need for admission to the hospital the day before surgery. Other reported benefits include a decrease in average costs associated with unnecessary laboratory tests, cancelled or delayed surgery, additional costs associated with intraoperative complications, and extended post-operative patient length of hospital stay (43,45-48). Improved clinical documentation and patient (including family and care givers) education are important advantages, as well (43,49). Preoperative assessment clinics typically are located in the tertiary care centre where the patient's surgery will take place.

The preoperative assessment clinic provides a good prototype to explore the advantages of taking a multiple method and interdisciplinary approach to study a health services research question – geographical access to a centralized health service. As mentioned earlier, access to health services is a multifaceted concept. For this reason, the study of access is ideal for the application of multiple research methods to more fully explore its dimensions. Further, the preoperative assessment clinic provides an ideal centralized health service because it is amenable to an interdisciplinary approach given that the concept of geographic access involves epidemiological and biostatistical principles (medical domain), geographical principles (geography domain), and behavioral components such as decision-making (social science domain).

As mentioned in the global overview (Chapter 3), the centralization of health services has taken place under the rubric of improving quality while gaining efficiencies through cost containment. To date, most of the evidence in the literature that supports this approach tends to focus on highly specialized technologies and services, such as cardiovascular procedures, cancer care, and neurosurgery, delivered in tertiary or quaternary centres (50). It is argued that the observed decrease in accessibility to many of these centralized services is offset by the realized cost savings, and more importantly achievement of the highest quality of care (50). Hence, the debate regarding limited access to these highly specialized complex treatments and services is somewhat muted in light of the significant gains achieved through centralization. Alternatively, the centralization of less specialized or lower technology services, such as preoperative assessment clinics, have not been studied to the same degree (i.e. tradeoffs between potential limited access and improvements in quality and cost) (50). Discussion regarding the geographical access to these services remains at the forefront of planning and policy setting. For this reason, an examination of access to the preoperative assessment clinic contributes to a gap in the literature regarding access to a centralized health service where the tradeoffs between high quality service/decreased cost and potentially limited access may not be as obvious.

The remainder of this thesis consists of three sub-studies that examine access to a preoperative assessment clinic located at a tertiary care centre, and concludes with an overall discussion on the findings of the studies. In the first study, geographical access to the preoperative assessment clinic is examined using a classical epidemiological and biostatistical approach. In the next study, a geographic information system is applied to visually inspect the spatial aspects of the data through the construction of maps and displays. In the third study one of the key stakeholders in the referral to the process is examined. Surgeons were interviewed and surveyed to assess whether patient location factors were considered in the referral decision-making process. And finally, the findings of the three studies are summarized and the merits of using a multimethods approach to explore access to the preoperative assessment clinic are discussed.

CHAPTER 4

STUDY I: CLASSICAL EPIDEMIOLOGIC APPROACH

Location of residence associated with the likelihood of patient visit to the preoperative assessment clinic (51)

4.0 STUDY I: CLASSICAL EPIDEMIOLOGIC APPROACH

Location of residence associated with the likelihood of patient visit to the preoperative assessment clinic (51)

4.1 Background

Prior to the development of preoperative assessment clinics, patients were typically admitted to the hospital before the day of surgery to undergo a medical evaluation by an anesthesiologist and when necessary, medical internists. The ultimate goal of the preoperative assessment clinic is to provide a cost efficient assessment of surgical patients prior to surgery. This is accomplished through a decrease in average costs associated with unnecessary laboratory tests, cancelled or delayed surgery, additional cost associated with intraoperative complications, and extended post-operative patient length of hospital stay (45-49). Further, the preoperative assessment clinic assesses patient health status to optimize perioperative management, acts as a vehicle for patient education, and provides patients and their families with an opportunity to ask questions about the surgery (43,49). Patient perceived benefits have been observed. In a study by Offiah and Grimley (52), 93% of patients reported that they had benefited in some way from attending the preoperative assessment clinic. Patients reported that the explanation of operative risks and benefits presented to them in the clinic was often their only source of this critical information.

The use of the preoperative assessment clinic is widespread in North American and the United Kingdom and evidence of associated cost savings is growing. However, knowledge regarding whether patients have equitable access to these important clinics, based on where they live, is unknown. Most preoperative assessment clinics are located near or within a tertiary centre where the surgery takes place. Access could be compromised for patients who must travel long distances to receive centralized preoperative assessment clinic services. As previously mentioned in Chapter 3 (i.e. Section 3.5 Global Introduction) several studies have examined geographical access to other medical services, such as cardiac procedures (27-28), breast cancer treatment (31), utilization of mammography (32), hospital discharge (34), and medical surgical care (35). A decrease in the utilization of these medical services was observed for patients living longer distances from these services. It is possible that access to preoperative assessment clinics may also depend on where a patient lives, thereby leading to restricted access for those living further away.

In this study, the association between geographical distance from a patient's residence to the preoperative assessment clinic located at a university-affiliated tertiary care centre, and the likelihood of a patient visit to this clinic prior to surgery is examined.

4.2 Methods

4.2.1 Data Sources

Hospital discharge data were used to identify all patients who underwent surgery at the Foothills Hospital, in Calgary, Alberta, between July 01, 1996 to March 31, 1998. Among these, all patients residing in the province of Alberta (whether inside or outside of Calgary city limits), as well as patients living in the neighboring provinces of British Columbia and Saskatchewan were included, because those provinces typically refer some patients to the Foothills Hospital in Calgary for tertiary care services. Individuals who lived beyond these areas were excluded since they were residents of other provinces and unlikely to be typical tertiary care referrals. Rather, it is likely that such cases represent individuals having surgery in Calgary because of personal ties to the city (e.g., friends or relatives residing in the city, in the context of permissible out-of-province surgery through Canada's inter-provincial portability of health insurance).

The surgical specialties of general surgery, cardiovascular/thoracic, gynecology, neurosurgery, orthopedics, plastic surgery, otolaryngology, urology, and oral surgery were included. Given the small number of patients in some specialties, the divisions of plastic surgery, otolaryngology, urology and oral surgery were combined into one group.

Discharge data were used to capture patient demographics, assessment and discharge dates, urgency of surgery (i.e. surgery that is necessary to mitigate what would otherwise be an imminently threatening medical condition), International Classification of Diseases, 9th Edition, Clinical Modification (ICD-9-CM) diagnostic and procedure codes (53), most responsible surgical specialty, and patient postal codes. Those who underwent emergent surgery, day procedures, or in the rare case had surgery cancelled after admission because of patient or surgeon decision, were excluded. Cases with a missing procedure or postal code were also excluded.

4.2.2 Variables

Preoperative Assessment Clinic Patient Visit

Patients who attended the preoperative assessment clinic at the Foothills Medical Centre before their surgery were identified by linking the hospital discharge data with preoperative assessment clinic booking data. Patients were matched on last name and date of birth. Surgical assessment dates that were within 60 days of preoperative assessment clinic consultation dates were considered a match. Dates beyond 60 days would most likely be the result of something else and were therefore excluded to avoid misclassification. The preoperative assessment clinic is a multidisciplinary clinic that is staffed by nurses, anesthesiologists and internists; individual patients see one or more of these provider groups depending on their clinical profile. Typically patients who are scheduled to have surgery attend the preoperative clinic 1-2 weeks before their surgery date. Once their assessment is finished they return home and come back again for surgery. For the purpose of this study, *any visit* to the preoperative clinic was assessed. A more detailed description of visits to the preoperative clinic, by provider type, is reported in a recent paper by Bugar et al (23).

Confounding Variables

Twenty-one patient comorbidities and procedures were identified through ICD-9 CM codes. The Deyo coding system (54) was applied to extract 17 comorbidities that comprise the Charlson comorbidity index, a measure of burden of comorbidity (55). An additional two procedures and two comorbidities that may predict preoperative assessment clinic utilization were also included: previous percutaneous transluminal coronary angioplasty (ICD-9-CM code V458.2), previous coronary artery bypass grafting (V458.1), hypertension (401.xx – 405.xx), and unstable angina (411.1). The selection of patient comorbidities and procedures for inclusion in this study were based on knowledge that these factors could alter a surgeon’s decision as to whether they would refer the patient to the preoperative assessment clinic prior to surgery. For example, the more comorbidities that an individual patient has, the more likely the patient would be referred to the preoperative assessment clinic.

Two clinical reviewers examined all primary procedure codes independently using a predetermined classification scheme to determine whether the surgical procedure was major or minor (23). Procedures involving brief anesthesia, limited tissue dissection, or anticipated short recovery period were considered minor. Discordant coding between reviewers was resolved by consensus (23).

4.2.3 Measurement of Distance

Distance from patient residence to preoperative assessment clinic was calculated by linking patient postal code to corresponding Canadian census enumeration areas using the Postal Code Conversion File (56). The single link indicator (SLI), included in the Postal Code Conversion File, was used to establish a one-to-one relationship between a postal code and an enumeration area. The SLI identifies the geographic area with the majority of dwellings using the particular postal code. Straight-line distance between the geographical centroid of the census enumeration area for the patient and the preoperative assessment clinic was calculated using the latitude and longitude data contained in the Postal Code Conversion File. The following formula was used:

$$d = R \arccos(\sin(lat1)*\sin(\sin(lat2) + \cos(lat1)*\cos(lat2)*(lon1-lon2))$$

where, R is the radius of the earth, d=distance, lat=latitude, lon=longitude,

1 = patient residence, 2 = preoperative assessment clinic (57)

4.2.4 Analysis

The likelihood of a patient visiting the preoperative assessment clinic before surgery was examined for each patient as a function of geographical distance from place of residence to preoperative assessment clinic. Graphical examination of the proportion of patients who visited the preoperative assessment clinic was undertaken using 50 km categories. Prior to categorizing distance, distance was examined as a continuous variable. This analysis revealed that the relationship between distance and visit to the preoperative clinic was not linear and hence violated the linearity assumption required for treating distance as a continuous variable. Categorical data were thus analyzed with chi-square tests and analysis of variance was used to compare age across distance strata. Multiple logistic regression models were used to calculate the adjusted odds of a patient visit to the preoperative assessment clinic as a function of distance, while controlling for other covariates. In order to calculate the crude odds of a preoperative visit, only distance categories were entered into the model. The adjusted odds of a preoperative visit were calculated by forcing all distance categories into the model and adding age, sex, major versus minor surgery, and urgency of surgery and all 21 comorbidity variables. As recommended by Sun (58), backward elimination was undertaken to remove non-significant (p >0.05 Wald test) covariates one at a time. The adjusted odds of a preoperative assessment clinic visit for only non-cardiac procedures were calculated using the same modeling procedures. This analysis was undertaken because it was suspected that cardiac surgery referral practices in the region studied might differ from other surgical specialties (23). An analysis, stratified by surgical division, was conducted to determine the adjusted odds of referral by distance category for each surgical division.

4.3 Results

Between July 01, 1996 and March 31, 1998, 9506 patients underwent surgery at the study hospital and met the inclusion criteria. Of these, 5602 (58.9 %) patients were referred and subsequently attended the hospital’s preoperative assessment clinic before surgery. The mean and median straight-line distance from place of residence to preoperative assessment clinic was 55.1 km (95% CI 53.1- 57.0) and 11.2 km, respectively. The shortest distance was 0 km, representing patients currently residing in long-term care at the study hospital, and the furthest distance was 878 km.

4.3.1 Unadjusted Utilization Rates

Among patients who lived between 0 - 50 km from preoperative assessment clinic, 66% attended the clinic (see Figure 1 on the following page). The proportion of patients who attended the clinic decreased to 52% for those living between 51 – 100 km. A further reduction was observed for each consecutive 50 km increment, resulting in 39%

for 101-150 km, 40% for 151-200 km, 30% for 201- 250 km, and 34% for distances greater than 250 km.

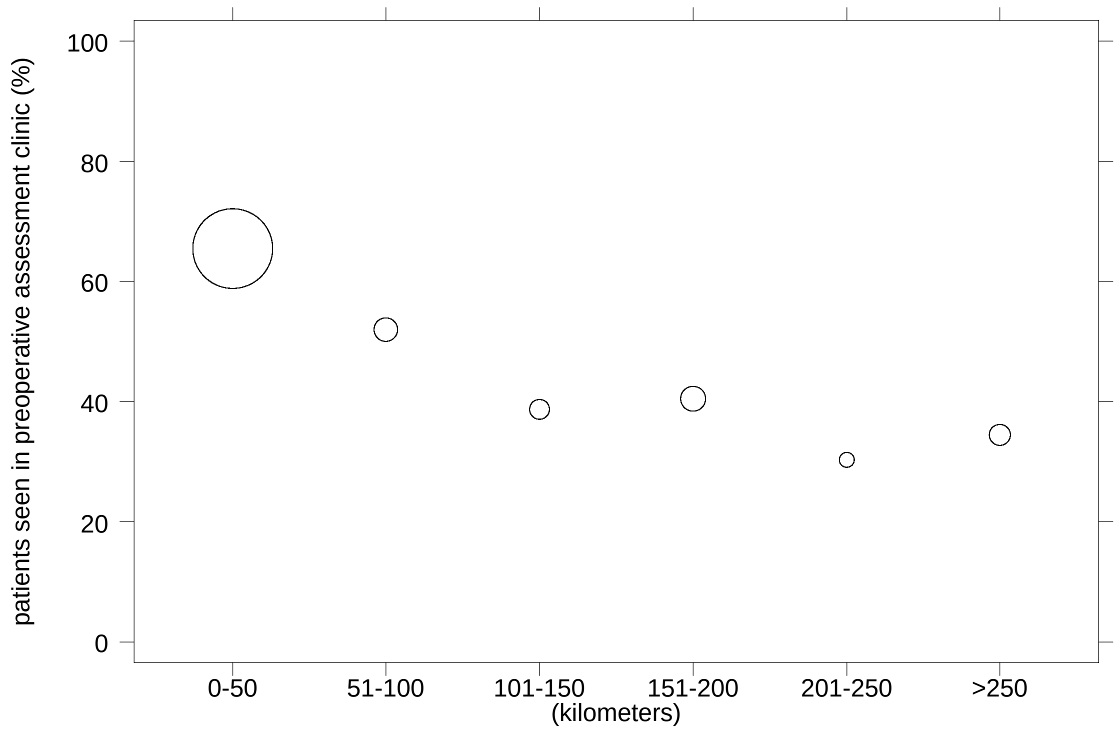


Figure 4.0 The proportion of surgical patients who visited the preoperative assessment clinic by distance. The size of each data point reflects the number of cases in each distance category.

4.3.2 Clinical Characteristics and Risk Factors

Table 4.0 on the following page summarizes the clinical characteristics of the 9506 patients by distance to preoperative assessment clinic. Patients living further distances from the preoperative assessment clinic tended to be slightly older, male, and undergo more urgent surgery than those who lived closer. A higher proportion of neoplasms and heart disease comorbidities were also present at greater distances.

Table 4.0 Characteristics of patients undergoing surgery by distance categories

Characteristics	0-50 km (n=6994)	51-100 km (n=612)	101-150 km (n=445)	151-200 km (n=680)	201-250 km (n=261)	>250 km (n=514)	P
age (mean in years)	52.7	54.7	54.9	54.5	55.7	54.6	<0.001
women (%)	59.1	60.1	52.1	47.2	43.3	49.0	<0.001
urgent assessment (%)	39.8	43.6	48.8	47.8	43.3	48.4	<0.001
major surgery (%)	61.2	61.8	62.9	64.1	65.5	64.2	0.35
chronic lung disease (%)	12.2	14.5	11.7	13.4	14.2	11.9	0.46
diabetes mellitus(%)	5.0	3.8	4.7	7.1	4.2	7.4	0.02
diabetes mellitus with complications (%)	1.2	1.5	2.3	1.8	0.4	1.4	0.25
mild liver disease (%)	0.4	0.5	0	0.3	1.9	0.2	0.003
moderate-severe liver disease	0.2	0	0	0	0.4	0.4	0.34
neoplasm (%)	14.1	17.3	18.4	16.2	16.1	20.0	<0.001
metastatic solid tumor (%)	5.5	8.8	6.3	9.1	5.4	10.3	<0.001
hemiplegia (%)	0.7	0.8	1.1	0.9	0	0.6	0.58
chronic renal disease (%)	0.5	0.5	0.5	1.6	0.4	0.2	0.008
dementia (%)	0.1	0.3	0	0.2	0	0.2	0.74
rheumatologic disease (%)	1.8	1.8	2.0	2.2	1.2	0.8	0.49
peptic ulcer disease (%)	0.7	0.5	0.5	0.6	1.2	0.8	0.89
unstable angina (%)	2.3	2.1	4.7	3.4	2.7	4.7	0.001
hypertension (%)	23.0	25.2	28.3	28.1	23.4	24.5	0.009
congestive heart failure (%)	2.6	3.8	3.8	5.4	5.8	5.6	<0.001
recent myocardial infarction	1.2	1.5	1.6	1.6	2.3	2.1	0.31
old myocardial infarction (%)	6.9	7.5	10.8	9.4	8.1	10.1	0.001
old percutaneous transluminal coronary angioplasty (%)	2.7	2.6	2.7	1.2	1.9	2.9	0.26
old coronary artery bypass graft (%)	1.8	1.6	1.6	2.4	0.8	1.8	0.70
cerebrovascular disease (%)	2.5	2.6	4.9	3.5	1.5	4.3	0.005
peripheral vascular disease (%)	3.4	3.3	2.9	4.9	4.6	4.3	0.26

4.3.3 Distance and Adjusted Utilization Rates

The crude and adjusted odds ratios of a patient attending the preoperative assessment clinic before surgery are displayed in Table 4.1.

Table 4.1 Odds ratios of preoperative assessment clinic utilization by distance compared with referent group (0-50 kilometers).

Distance	Crude OR (95% Confidence Interval)	Adjusted OR* (95% Confidence Interval)	Adjusted OR non-CVT† (95% Confidence Interval)
0-50 km	1.00 (reference)	1.00 (reference)	1.00 (reference)
51-100 km	0.57 (0.48-0.67)	0.52(0.44-0.63)	0.43 (0.36-0.53)
101-150 km	0.33 (0.27-0.40)	0.32 (0.26-0.39)	0.28 (0.22-0.36)
151-200 km	0.36 (0.30-0.42)	0.34 (0.29-0.40)	0.30 (0.25-0.37)
201-250 km	0.23 (0.17-0.30)	0.20 (0.15-0.26)	0.18 (0.13-0.26)
>250 km	0.27 (0.23-0.33)	0.26 (0.21-0.31)	0.20 (0.16-0.25)

*Adjusted for age, gender, urgency of surgery, major versus minor surgery, comorbidities
† Adjusted for age, gender, urgency of surgery, major versus minor surgery, comorbidities excluding cardio/thoracic surgical specialty

The crude analysis demonstrates that patients were less likely to attend the preoperative assessment clinic prior to surgery as distance from the clinic increased. For example, patients who lived 50 km to 100 km from the clinic had approximately half the odds of being seen in the preoperative assessment clinic than did patients who lived closer (crude OR = 0.57; 95% CI 0.48-0.67), while patients who lived furthest from the clinic had approximately one-quarter the odds of being seen. Adjustment for differences in clinical factors, urgency of surgery, and whether the surgery was major or minor, had little effect on the odds ratio of attending the preoperative assessment clinic. After removing cardiac surgery cases from the multivariate model, because of suspected differences in referral practices, and adjusting for differences in the covariates above, there was a slight decrease in the odds of attending the preoperative assessment clinic across distance categories.

4.3.4 Distance and Utilization by Surgical Specialty

Variation in the crude proportion of patients attending the preoperative assessment clinic was noted across surgical specialties and distance categories (Table 4.2).

Table 4.2 Crude proportion of preoperative assessment clinic utilization by surgical division and distance category (number referred/number operated)

Surgical Division	0-50 kilometers	51-100 kilometers	101-150 kilometers	151-200 kilometers	201-250 kilometers	>250 kilometers
All divisions	65.5% (4581/6994)	52.0% (318/612)	38.7% (172/445)	40.4% (275/680)	30.3% (79/261)	34.4% (177/514)
General	76.3% (1415/1854)	66.2% (100/151)	51.4% (37/72)	44.1%) (41/93)	45.7% (16/35)	51.3% (39/76)
Cardio/thoracic	49.6% (670/1351)	52.3% (67/128)	34.6% (45/130)	39.2% (91/232)	29.4% (32/109)	38.5% (62/161)
Neurosurgery	72.5% (665/917)	57.1% (48/84)	43.5% (47/108)	56.5% (87/154)	40% (18/45)	37.7% (35/93)
Orthopedic	59.8% (503/841)	52.4% (43/82)	50.0% (17/34)	30.6% (22/72)	27.6% (8/29)	26.3% (15/57)
Gynecology	67.3% (922/1371)	38.8% (47/121)	29.2% (21/72)	25.0% (22/88)	16.0% (4/25)	21.1% (19/90)
Other*	61.5% (406/660)	28.3% (13/46)	17.2% (5/29)	29.3% (12/41)	5.6% (1/18)	18.9% (7/37)

*Other includes surgical specialties plastic, oral, otolaryngology and urology

For all specialties, patients living within 50 km had the highest utilization rate (50% to 76%). A higher proportion of general surgery patients were seen in the clinic compared to the other surgery specialties for all distance categories except 151 to 200 km. After adjustment for differences in clinical factors (i.e. age, sex, and comorbidities), urgency of surgery, and whether the surgery was major or minor, the proportion of patients medically assessed in the clinic remained higher at closer distances to the preoperative assessment clinic for all surgical specialties (Table 4.3). It was noted that for cardiac surgery the ‘distance decay’ effect appeared at larger distances from the preoperative assessment clinic.

Table 4.3 Adjusted odds ratio† of preoperative assessment clinic utilization by surgical division and distance compared with referent group (0 to 50 kilometers)

Odds Ratio (95% Confidence Interval)						
Surgical Specialty	**0-50 kilometers**	**51-100 kilometers**	**101-150 kilometers**	**151-200 kilometers**	**201-250 kilometers**	**>250 kilometers**
General	1.00 (reference)	0.54 (0.37-0.79)	0.35 (0.21-0.57)	0.24 (0.15-0.38)	0.27 (0.13-0.56)	0.31 (0.19-0.51)
Cardio/Thoracic	1.00 (reference)	1.05 (0.71-1.55)	0.46 (0.31-0.69)	0.53 (0.39-0.72)	0.32 (0.20-0.51)	0.60 (0.42-0.86)
Neurosurgery	1.00 (reference)	0.48 (0.30-0.77)	0.26 (0.17-0.40)	0.48 (0.33-0.69)	0.23 (0.12-0.43)	0.23 (0.14-0.36)
Orthopedic	1.00 (reference)	0.82 (0.47-1.43)	0.72 (0.31-1.66)	0.24 (0.13-0.44)	0.20 (0.08-0.48)	0.17 (0.09-0.34)
Gynecology	1.00 (reference)	0.22 (0.15-0.34)	0.18 (0.10-0.32)	0.19 (0.11-0.34)	0.07 (0.02-0.30)	0.13 (0.07-0.23)
Other*	1.00 (reference)	0.23 (0.12-0.47)	0.13 (0.04-0.35)	0.20 (0.09-0.42)	0.04 (0.01-0.30)	0.12 (0.05-0.30)

* Other includes plastic, oral, otolaryngology and urology surgical specialties
†Adjusted for age, gender, urgency of surgery, major versus minor surgery, co-morbidities

4.4 Discussion

The present study demonstrates that the likelihood of a patient visiting the preoperative assessment clinic prior to surgery decreases as distance to the clinic increases. This ‘distance decay’ effect appears to persist after adjustment for clinical factors, surgical specialty, urgency of surgery, and whether the surgery was major or minor. Variation in utilization was also noted across surgical specialties and distance categories.

4.4.1 Implications

The significance of these findings has implications for a considerable portion of the population who rely on health services in the regional tertiary care centre that were studied. The province of Alberta has a population of approximately 3 million. The two metropolitan health regions in the province (i.e. the Calgary Health Region and the Capital Health Region in and near Edmonton) provide health services to approximately 1 million people each, constituting 67% of the total provincial population. The remainder of the population (i.e. 1 million) lives outside of these two immediate metropolitan areas. In this study, 26% (N=2512) of the 9506 surgical patients lived further than 50 kilometers from the Foothills Hospital, which is the main tertiary care facility in the Calgary Health Region.

Sizable literature exists on the importance of preoperative assessment and potential benefits to both patients and the health care system. Further, preoperative assessment is recognized as an important discipline in medicine. Previous studies have identified that clinical and other factors are important in the referral and utilization of preoperative assessment clinics. In a study by Bugar et al (59), clinical factors were strongly associated with patient referral and utilization of the preoperative assessment clinic. Further, surgical specialty and type of clinic consultation were also factors in patient referral and utilization. For example, the overall utilization rate of the preoperative assessment clinic for general surgery patients was 72%, while the consultation rate for this patient group was 19% for general internists and 39% for anesthesiologists, whereas overall utilization for neurosurgery was 63%, while the consultation rate for this patient group was 24% for general internists and 19% for anesthesiologists. The present study was designed to identify whether patient distance from the preoperative clinic was also an important factor, independent of such clinical factors. The results of this study suggest that patient distance from the clinic is indeed an important factor, and is in fact as important as clinical factors. Further, Table 4.0 displays how specific clinical factors play out by distance categories

Inequitable geographical access has significant implications given the identified and potential benefits of preoperative assessment for patients and the health system. For instance, decreased costs due to a reduction in laboratory testing, and a decrease in delayed or cancelled surgical procedures were reported benefits to the health systems in the United Kingdom and United States (45-47). Although a decrease in clinical outcomes such as perioperative complications has not been substantiated as yet, studies have indicated that this is a potential benefit but one that is difficult to confirm (45,49). Further, the preoperative assessment clinic provides patient-centred care. Patients and family members have an opportunity to discuss their concerns, medical risks, lessen anxiety, and obtain information about their surgery (49,59).

A second benefit of the preoperative assessment clinic is improved clinical documentation. Enhanced reporting of clinical information in patient charts can assist health professionals in making optimal perioperative management decisions. Good clinical documentation also provides the essential data needed for ICD-10 coding, costing, and billing (49,59). Preoperative assessment clinics introduce a streamlined process for the patient and the health system through the use of standard assessment forms, provision of diagnostic services in one locale, and more complete medical records.

If we conclude that the inequitable access is problematic, what might be some of the solutions? One possibility is to ask all patients to travel for preoperative assessment clinic. This may or may not be acceptable to the general public because of personal, family, occupational, or financial reasons. Alternatively, satellite preoperative assessment clinics could be established, but this would obviously have staffing and health system cost implications. However, this may be a more appropriate option in a health system such as Canada's that strives to achieve universal access, compared to the alternative above that would result in a shifting of costs from the health system to the patient. The burden of these extra costs on rural and remote residence can be significant, as demonstrated in an Australian study that examined the costs of accessing a surgical specialist (60). Patients, who accessed a local as opposed to a metropolitan surgical specialist, were able to save an average of $1077 AU in out of pocket costs per specialist visit.

Another potential solution is the use of telemedicine technology. As telemedicine becomes more widespread, this alternative may be increasingly viable with time (61-62). Once again this would have staffing, training, funding, and physician compensation implications.

Another 'remote triage' solution that is used in some settings is to have an anesthesiologist contact the patient at home by telephone to get a sense of whether a patient needs specialist consultation or specific tests prior to their surgery. Alternatively we could simply accept that preoperative assessment clinic assessment is not feasible for remote patients. However, some patients from remote regions might object to this status quo. This option is also of concern given that patients are being encouraged to participate in their own medical management as health care moves toward patient-centered care. Also, many surgeons might prefer or demand preoperative assessment clinic consultation prior to performing surgery. Patients could be seen immediately prior to surgery, eliminating an additional trip for the patient, and gaining some benefits such as patient centred care and documentation. However, the benefit of avoiding the cancellation of surgery would not be attainable. The development of referral guidelines to assist surgeons in deciding which patients should be sent to the preoperative clinic prior to surgery would also be helpful. The surgeon would be better prepared to identify and consult patients living in remote areas regarding the need for further medical assessment regardless of the patient's distance from the clinic.

The present study identifies a need for further inquiry into the complex referral and utilization process in order to gain insight into stakeholder decision-making. For example, a survey would be helpful to identify the general public's willingness for extra travel, as well as objections to being "passed over" for preoperative assessment clinic. Surgeons could be asked about their willingness to forego preoperative assessment clinic or their tendency to simply skip preoperative assessment clinic for remote patients where they otherwise might refer them to preoperative assessment clinic. Consulting internists are also important stakeholders who could be questioned about their willingness to participate in satellite preoperative assessment clinics or work through telehealth.

4.4.2 Study Limitations

The present study has several limitations, the first of which is that only one preoperative assessment clinic in a single health region in one province was studied. The study findings may not apply to other health regions or provinces, although past studies have found similar distance decay effects for other health services (27,28,31,32,34,35).

Second, the current study was undertaken in a single universal insurer health care system, and hence may not apply to other countries. However, studies from the United States and United Kingdom that examined geographical access also identified a decrease in utilization with increasing distance from the health service (27,28,30-32,34,35,63). It is possible that patients at large distances from the preoperative assessment clinic received some form of preoperative assessment from their local physician or specialist outside of the clinic. For example, we know that patients undergoing cardiac procedures at this site are typically seen by a cardiologist whether or not they attend the preoperative assessment clinic, and possibly because of this, it was noted in the present study that cardiac surgery patients did not appear to be as affected by distance as patients undergoing other surgical procedures.

There may also be other non-clinical confounders that were not captured or controlled for in this study that may have influenced referral to preoperative assessment clinic. For example, patients living in remote areas may have refused or were unable to travel to the preoperative assessment clinic. Additionally, it should be noted that our method of ascertaining patient comorbidities might have introduced information bias relating to differential documentation of comorbidity information in those seen in the preoperative assessment clinic versus those not seen (i.e. better documentation in the former). However, if present, such a bias would lead us to *underestimate* the already higher level of comorbidities observed in our distant population, and thus would not have changed the overall conclusions of our study.

The use of straight-line distance to measure geographical access to the preoperative assessment clinic has some limitations. Research has shown that road network distance measures or travel times to a hospital more closely reflect ‘true’ distance because they take into account geographical and physical impeding structures such as roadways, mountains, rivers, etc (64). For these reasons, network and travel distances typically contain fewer errors and result in longer distance measures. As well, it should be noted that consideration of these features is likely less important in urban areas that are typically setup on a grid system, than in rural areas where geographic and physical structures are more prevalent (64). However, the choice of whether to use a simple straight-line distance calculation versus network distance depends on the type of question under study. The focus of the present study was on the relative, rather than the 'true' magnitude of distance and its effect on patient visits to the preoperative clinic. Further, the choice of distance measure was based on the assumption that straight-line distance is proportional to road network distance (65-66). Further, it has recently been demonstrated that straight-line distance is strongly associated with patient reported travel times and estimated roadway distance (67). It should also be noted that the use of centroids to approximate the location of patients introduces an additional source of error since these do not refer to the actual address of the patient. The amount of error introduced can vary depending on whether the patient lives in an urban or rural location (68-69).

Yet another caveat is that the current study only examined *actual utilization* of the preoperative assessment clinic. Although it is possible that some of the referred patients may not have actually attended the clinic, the booking procedures for non-emergent surgery in the hospital studied are such that the vast majority of referrals actually lead to a clinic visit (-- because planned surgical procedures are usually delayed or even cancelled if a patient does not attend the preoperative assessment clinic after a referral has occurred). On a final note, the specialties of urology, plastic, oral and otolaryngology surgery were grouped because the relatively small number of surgical cases performed by each of these divisions would yield statistically unstable point estimates for the preoperative assessment clinic visit odds ratios. After grouping these small divisions into a single combined grouping of "other" surgical divisions, the relationship between patient visit and distance from the clinic remained.

4.5 Conclusion

The present study demonstrates that the likelihood of a patient visit to the preoperative assessment clinic appears to depend on the geographical location of patients' residences. Patients who live closest to the clinic tend to visit the preoperative assessment clinic more often than patients who live in rural and remote areas. This observation may have implications for achieving the goal of equitable access for all patients, independent of where they live. Given the complexities of the referral and utilization process, further study into stakeholder decision-making is required to more fully understand this phenomenon.

The following two studies examine the distance-utilization relationship in greater detail. In Chapter 5, the spatial aspects of patient location and preoperative assessment clinic utilization are examined using a geographic information system and mapping. The third study (Chapter 6), explores whether patient location factors are considered in the surgeon referral decision-making process.

CHAPTER 5

STUDY II: CARTOGRAPHIC VISUALIZATION USING GIS

5.0 STUDY II: CARTOGRAPHIC VISUALIZATION USING GIS

5.1 Background

5.1.1 Mapping: An Art and a Science

Maps comprise a complex form of communication and their construction is considered by many to be both an *art* and a *science* (70). Robinson et al (71) argues that the most important aspect of map construction is the application of scientific principles, yet he recognizes the importance of the *art* in the overall design. Alternatively, Keates (72) acknowledges that scientific principles are important but emphasizes that the *art* elements of map design are the most critical components for effective communication. Despite the *art* versus *science* perspectives, most tend to agree that the primary purpose of a map is concisely to communicate spatial aspects of reality (e.g., distribution and pattern) in a condensed format.

Maps have numerous benefits and appeal to a variety of disciplines. First, maps have a logical connection with spatial relationships (e.g., maps consider the spatial dimensions of data). Second, given current technology such as geographic information systems (GIS), maps can easily be manipulated to explore data. Maps possess a scientific utility because they provide a means to visualize, explore, display spatial distributions, and uncover subtle patterns in the data (73). This is of particular importance given that aspatial analytical techniques are inadequate to study spatial phenomenon (74).

5.1.2 Maps and Cartography

A review of the research in cartography (map making) and particularly medical cartography is beyond the scope of this chapter. However, it is important to provide a brief background and introduce the concept of cartographic visualization as it relates to the construction maps and the exploration of spatial data.

Maps constitute an essential feature of geography and have long been recognized as powerful visual tools (71). Presentation remains the basic task of cartography (73). During WWII, Robinson influenced the design of US military maps by emphasizing map functionality as opposed to graphic design (75). Later, his publication “The look of Maps” in 1953, was the driver for research and development in the area of map design and map elements (75). This led to decades of research in cartography devoted to the study of map elements and the establishment of guidelines, traditions, rules and principles for effective map construction and communication (76). For example, Bertin's elements (e.g., position, form, orientation, color, texture, value, size) were established by1983, with further developments by others such as MacEachern (76). Today, Robinson et al (71) and Slocum (73) constitute two frequently sited authoritative resources for the design of maps and the introduction of cartographic visualization.

5.1.3 Cartographic Visualization

Cartographic visualization or geographic visualization stems from cartography. Given that maps are visual products that represent reality, theory and research in the area of scientific visualization apply to the production of maps. Advances in cartographic visualization mirror developments in both GIS and cartography, demonstrating significant growth in these areas since 1987 (77).

5.1.3.1 Theoretical Models

Traditionally, the communication model was used to describe the production and use of maps. Emphasis was placed on cartographic presentation. The communication model, shown in Figure 5.0, depicts a linear process (73,78-79). The desired end product of this approach is the construction of a single "best" static map that typically focuses on one spatial pattern. Implicit within this approach is the assumption that the cartographer knows what information should be communicated to the user (78).

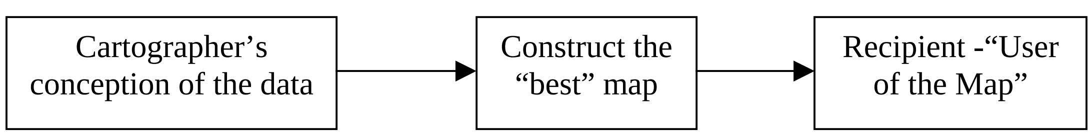


Figure 5.0 Map communication model (78)

In the 1990s, there was a shift from the cartographer-driven communication model (i.e. cartographic representation/communication) to user-driven cartographic visualization (map use and how users interact with maps) (80). This move was partially facilitated by developments in geographic information systems (GIS), whereby the user or researcher could more easily explore the spatial aspects of their data in an interactive environment (73).

Despite a common point of origin (i.e. cartography), cartographic visualization has different meanings in the field of cartography. Jiang (77) considers cartographic visualization as both an analytical and communication tool that is primarily concerned with the visual representation of spatial or geographic data. Similarly, Wolff (81) suggests that visualization should be viewed as a scientific analysis process. In this sense, visualization is regarded as an extension of spatial analysis. However, Bailey and Gatrell (82) argue that there is a distinction between cartographic visualization and exploratory spatial data analysis, based on the degree of data manipulation. They contend however, that the distinction between these two areas is more obscure as developments continue in cartographic visualization. Further, MacEachren (76) describes visualization as an interactive exploratory activity in a dynamic environment that is conducted by the researcher or cartographer. Figure 5.1 presents MacEachren's well-recognized and referenced hermeneutic model of cartographic visualization (73,76,78).

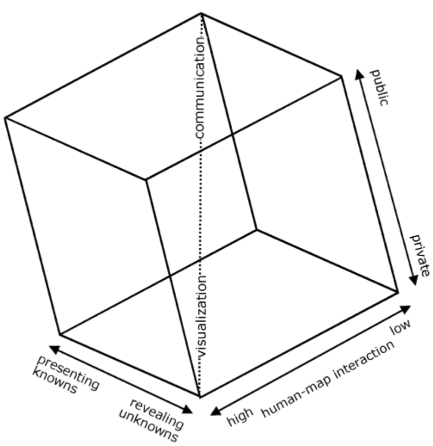


Figure 5.1 MacEachren's hermeneutic model of cartographic visualization
Source: Scanned from Hallisey (78)

Although the definitions of cartographic visualization differ somewhat, the ultimate goal is to explore and understand spatial information (77). Further, it is recognized that the construction of maps is no longer reserved for cartographers. The widespread use of GIS has allowed researchers to also play the role of the cartographers. As well, research in cartographic visualization has shifted away from the optimal design of map elements, to how people (researchers/users) use, interpret and manipulate maps to explore and understand spatial data (73).

5.1.3.2 The Application of Cartographic Visualization

Cartographic visualization is considered an iterative exploratory process that typically involves GIS (76). Given its exploratory characteristics, there is no single correct way to display data. In fact, multiple views and perspectives are vital to exploring and understanding spatial data. Maps are often not produced as final products, but rather as intermediate products. Hence, the map is no longer simply a communication tool but an aid to revealing spatial patterns and structures (77). The analytical aspect of cartographic visualization involves the creation of maps. However, a great deal of effort is spent exploring various aspects of the data and then selecting the best ways to present the information in a meaningful way in map form (refer to Figure 5.2).

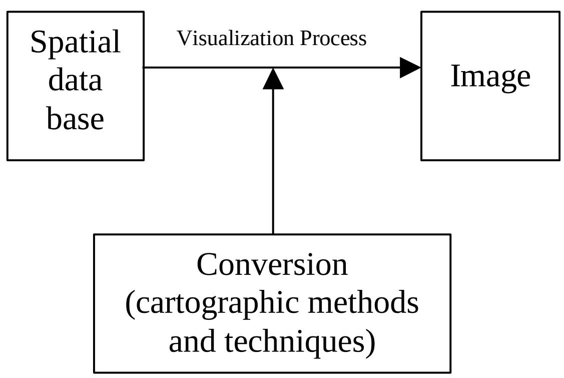


Figure 5.2 Cartographic visualization process (79)

As mentioned earlier, the user is often the cartographer or works closely with those who are performing the cartographic visualization processes. This is a critical distinction from cartographic representation or communication where the map is the result of the cartographer's interpretation of the data. It has been argued by some that the construction of maps by researchers or users can be risky because these individuals may not apply established and tested techniques, which can result in misleading information (78). Of note however, is that a certain degree of cartographic expertise is often incorporated in many GIS software packages on the market today. Further, as researchers and users become more familiar with cartographic visualization techniques, it is believed that appropriate techniques, rules and standards will be learned and applied (78). It can also be argued that the advantages of the researcher as the cartographer are particularly important for the visualization process. The researcher typically has the advantage of knowing and understanding the data and can therefore explore spatial aspects of the data through both static and dynamic maps. Further the process of exploration and visualization leads to the development of new questions and hypotheses that may not have been realized at the beginning of the analysis process, but are the resultant effects of the visualization process and exposure of unexpected patterns. A second advantage is that researchers can generate and present information that is meaningful to them. This is one of the biggest strengths of the cartographic visualization process. Table 5.0 below summarizes the differences between traditional cartography and cartographic visualization.

Table 5.0 Comparison of cartographic communication and cartographic visualization

Cartographic Communication	Cartographic Visualization
Traditional cartographer creates the map.	Researcher or user creates the maps.
Supply and cartographer driven.	Demand and user/researcher driven.
Maps are the end product.	Maps are intermediate products that constitute part of the exploration and visualization process.
Construction of the optimal map or single "best" map. Underlying assumptions: (1) optimal way to present information (2) cartographer knows the most important information to present	Construction of multiple maps with differing information. Use of graphics (maps, tables, charts) to explore ideas and understand data (data exploration). There is no single "best" map.
Map centered approach to design.	Researcher/user centered approach to exploration and design of maps.
Specialized maps (e.g., city maps)	Thematic maps (e.g., choropleth maps)
Emphasizes map design.	Emphasizes map use, interpretation and manipulation.
Static environment.	Dynamic environment.
Display information.	Explore information.

Source: Based on (76-81)

Numerous GIS techniques and tools are available that support the cartographic visualization process. The types of information that can be explored through the process of cartographic visualization and the types of activities that can be undertaken include (73,79,83,84):

1. examine geographic phenomena
2. locate features or attributes and examine the spatial distribution of the data
3. determine the characteristics of features by location
4. determine how features or attributes on one layer relate to other layers
5. identify anomalies in the data
6. synthesize data to identify patterns
7. explore data through interactive queries, re-expression (change display of the data. For example, point pattern, choropleth, proportional symbol), multiple views, linked views (e.g., link maps with other graphics – charts, tables)
8. confirm assumptions or explore hypotheses about geographic phenomena
9. generate hypotheses and apply statistical methods to test hypotheses
10. present geographic information (e.g., paper-based, animation, web-based mapping, fly-through, and the integration of sound and graphics)

5.1.4 Types of Maps

Generally, maps can be classified into two different types of formats. General reference maps refer to maps that convey information about where things are in relation to each other (e.g., city map), whereas thematic maps provide information about a particular theme or themes (73).

Thematic maps (also referred to as "subject" or "statistical" maps) are important in medical geography, particularly medical cartography (74). They provide an approach to mapping health and medical data in a spatial form. In fact, Barrett (85) suggests that the development of medical cartography did not take place until thematic maps were developed. Thematic maps are used to (a) portray spatial patterns (b) provide information about a particular location, and (c) compare patterns on two or more maps or map layers. There are a wide variety of thematic maps (e.g., categories map type, features map type, quantities map type) (75). The choice of map type and its application depends on the purpose for constructing the map. There is no single correct way to classify data and no one right map (78).

Area or choropleth maps play an important role in exploratory analysis. They avoid spurious detail and enhance readability by aggregating data in areal units typically defined by administrative or political boundaries. Area maps are most often used to display the intensity of a phenomenon using standardized data such as ratios and rates. On the downside however, the modifiable areal unit problem could result in observed patterns that are artifacts of the data aggregation process as opposed to the identification of "real" phenomenon in the problem under study (74). As well, area maps do not portray variation or clusters that may exist within areal units. Hence, the selection of boundaries and an awareness of the data that are aggregated are important to keep in mind when analyzing geographical patterns using area maps.

Point pattern maps incorporate a single point on the map for every observation in the data, permitting the examination of data at the individual level. Some form of spatial referencing, such as postal codes, is required to construct the map. This is then linked to the point on the surface of the earth. Again, the distribution of points in space is assessed for patterns (e.g., clustering of points can be both observed and statistically analyzed). Dot or point pattern maps are most often used to present raw count data and they more accurately show the location of the phenomenon.

5.1.5 Brief History of Map Use in Epidemiology

Mapping has an extensive history dating back thousands of years as evidenced by tablets found in Iraq (85). Maps have also had a long history in health and medicine. As mentioned in Chapter 1, John Snow (1848) and lesser-known Valentine Seaman (1798) used maps to describe the distribution of disease and support their hypothesis regarding the causal effects of cholera in England and yellow fever in New York. These works however, are not the first epidemiological maps. Barrett (85) researched the origins of both medical geography and the development of medical cartography. He defines medical cartography as the mapping of medical geographical relationships between disease, nutrition, and medical care as a discipline. According to Barrett (85), links between disease and geography date back 2500 years to the Greeks and Romans.

Epidemiological maps describing the location and intensity of the plague and intermittent fevers were constructed in Italy from 1514 to 1732. Today, mapping in health and medicine has experienced an explosion largely due to the development of geographic information systems (GIS) (16). Disease mapping continues to dominate the use of maps in medical geography (e.g., cancer, chronic disease, tracking epidemics/pandemics, etc.) (86). However, the utilization of maps in health services research is experiencing considerable growth over the past decade (86).

5.1.6 Maps, GIS and Health Services Research

A geographic information system (GIS) provides a tool for examining and linking spatially referenced data. GIS is defined as:

> - *a powerful set of tools for collecting, storing, retrieving at will, transforming and displaying spatial data from the real world for a particular set of purposes. [Burrough, p 11]*

Burrough and McDonnell (87), and Longley et al (88) provide additional definitions. Within the context of health services research, Gatrell (16) defines GIS as an extension of statistical analyses that join epidemiological, sociological, clinical and economic data within a spatial environment. GIS was developed in Canada in the 1960s as a computerized map measuring system (87). It has undergone significant growth in the past two decades with the expansion and use of high-powered personal computers (87). GIS is an appealing technology particularly because of the need for spatial information in health services research that focuses on health needs, patient behaviors, health outcomes and access to services (89). The ultimate goal is to achieve an enhanced understanding of the health problem under investigation. In this way, GIS provides a framework to explore and integrate various methodological approaches and provides a set of tools for exploring different types of questions (73). Additionally GIS can be used to analyze spatially referenced health data at the individual-level without the need to aggregate the data that would otherwise result in a loss of critical information.

The benefits and usefulness of GIS in health research are described in Cromley and McLafferty (90). For example, access to health services can be explored through combining and analyzing data from multiple sources. Maps are then constructed to explore and display this information and examine variation in access across geography and subpopulations. Despite recognized benefits, unfortunately many studies tend to utilize GIS primarily as simply a mapping tool (89).

GIS has been applied in numerous studies to explore the distribution of disease, access to hospital services, resource allocation, health care delivery, and the impact of distance on access (42,47,91-98). McLafferty (89), Ricketts (99), and Higgs (86) present reviews of the most recent studies that utilize GIS in health research. For example, McLafferty (89) discusses recent literature in terms of three major themes; namely medical need, access, and utilization.

5.1.7 Exploratory Spatial Analysis

Exploratory spatial analysis is a general term that is used to describe various analytical procedures (87-88). Jarrett et al (100) divides spatial analysis in a GIS environment into three broad categories: (a) *visualization*, (b) *exploration*, and (c) *modeling*. *Visualization* involves the linking of attribute date (e.g., preoperative assessment utilization rates) to locations on the earth's services (e.g., longitude and latitude) (100). Variables can then be visualized and reclassified to provide clues about the relationships between the attribute data and geographical placement. *Exploration* extends the visualization process by employing spatial queries and overlay techniques, while *modeling* combines visualization and exploration with statistical analysis (100).

Similar to statistical analysis, data categorization in cartographic visualization requires careful consideration. Further, the selection of cartographic elements to display the information in a visual format such as maps also requires careful thought. The selection of elements involves a trade-off and recognition that the resultant maps will always be biased in some manner. Monmonier (101) presents a variety of problems that are encountered with the inappropriate categorization of spatial data and the application of map elements resulting in the naïve or purposeful communication of biased information.

Some of the techniques used for exploratory spatial analysis as described above include but are not limited to geocoding, spatial overlay, and buffer, proximity, network and cluster analyses. The procedures employed in the exploratory data analyses for this study are briefly described below.

5.1.4.1 Address Matching (Geocoding)

Locational information is available in several forms such as a street name or postal code. In order for GIS to utilize this information in a spatial manner, a process known as geocoding must be performed (88). Geocoding involves linking locational information to a physical location on the surface of the earth. In case of the present study, the locational information file is linked to a spatial data set that contains postal codes (e.g., Statistics Canada Postal Code Conversion File). The GIS uses this information to assign x and y coordinates to the postal codes in the file (e.g., longitude and latitude) (87-88). The result is a new spatial data layer of point locations representing surgical patient postal codes.

5.1.4.2 Spatial Overlay

One way to identify spatial relationships is through spatial overlay (e.g., comparisons of two or more phenomenon with the view of determining similarities and differences). This process involves joining separate data sets that share all or part of the same spatial area. A new data set is created that identifies spatial relationships when all layers are viewed simultaneously (88). Additionally, a new table is generated that contains all of the data from both data sets as well as the new variables that are created through the joining process (e.g., event counts within a polygon).

5.1.4.3 Buffer and Proximity Analysis

Buffering is one of the most important transformations in GIS (88). Essentially, a buffer is a new polygon that is created by specifying a certain distance from a given point location (87). The process involves generating a buffer around specified geographic features (e.g., Foothills Medical Centre), followed by identifying features of interest that are contained inside or outside the buffer zone (e.g., patients who are seen in the preoperative assessment clinic versus patients who are not seen in the clinic).

One way of analyzing the location of features is through proximity analysis. This involves measuring the distance between features in a given area. The distance between two points may be measured as a straight-line or through a network path such as a roadway network (102). Once distances are determined through a GIS, other information from the database can be analyzed.

5.1.8 Study Purpose

The overall purpose of this substudy is to use cartographic visualization to explore the spatial aspects of surgical patient access to the preoperative clinic. The perspective of the researcher as cartographer is taken. The preoperative assessment clinic data set analyzed in Study I (refer to Chapter 4) is assessed using geographic information system (GIS) software (103).

The specific objectives of this substudy are to apply cartographic visualization techniques:

(1) to explore the spatial relationship between patient location and geographic access to the preoperative assessment clinic,
(2) to construct and present the preoperative assessment clinic data in map-form,
(3) to critique the maps constructed through the iterative cartographic visualization process, and
(4) to describe the observed geographic patterns related to patient location and distance to the preoperative assessment clinic.

5.2 Methods

5.2.1 Data Sources

The data sources used in this study included:

(1) The administrative data file analyzed in Study I – preoperative assessment clinic data file (refer to Chapter 4).
Sources: Corporate Data, Calgary Health Region plus the Foothills Hospital preoperative assessment clinic dataset

(2) Boundary files:

(a) Health regions for Alberta, British Columbia, and Saskatchewan (1998)
Source: Statistics Canada

(b) City of Calgary Communities (1998)
Source: MADGIC GIS Resources, University of Calgary

(3) Network files:

(a) Roadways – Alberta, British Columbia, and Saskatchewan
Source: MADGIC GIS Resources, University of Calgary

(b) Point Files: Postal Code Conversion File (June 2000)
Source: Statistics Canada

5.2.2 Data Categorization

Histograms of the data were used initially to explore the data prior to categorization. Several methods and classification groups were explored to attain the most appropriate fit of the data. A minimum of four and a maximum of eight categories were explored to ensure that distinct patterns could be observed. While categories greater than eight or unclassified can potentially reveal more complex and subtle patterns, these were not used because it is difficult to match shading on a map with a high number of categories in the map legend. Data were either categorized using natural breaks (Jenks method) (88) or manual breaks that have particular meaning (e.g., percentages). Natural breaks minimize differences between values within classes and maximize difference between values in different classes (101). ArcGIS uses algorithms to create statistically significant groupings in the data (103). As suggested in Monmonier (101), non-continuous scales were used to categorize data that contained extreme outliers.

Straight-line distance categories were determined in Study I (refer to Chapter 4). Data were mapped and reported using raw count data and the proportion of patients who attended the preoperative assessment clinic. The observed-to-expected ratio for patient attendance at the preoperative assessment clinic was calculated for each distance category. The overall observed population rate was calculated by dividing the total number of patients who attended the clinic by the total number of surgical patients in the study.

5.2.3 Visualization, Mapping, and Exploratory Analysis

ESRI ArcGIS 9.1 software was used to conduct all analyses and construct the maps (103). Patient postal codes were linked to geographic coordinates contained in Statistics

Canada's Postal Code Conversion File in the previous study (refer to Chapter 4). Postal codes were mapped using the x and y coordinates that correspond to the latitude and longitude of the North American Datum of 1983, Zone 11N coordinate system.

Geographic access to the preoperative assessment clinic was analyzed and examined using several methods. Selected features of one layer were used to select features of another layer (e.g., City of Calgary community boundaries were used to select all preoperative assessment clinic patients who resided within Calgary). Overlay operations on two of more input layers was undertaken to create new layers (e.g., provincial health regions, Foothills Hospital location, and surgical patient location). Spatial joins were conducted by relating the attributes of one layer to another based on the spatial relationship between the layers' features (e.g., provincial health region boundaries were used to create patient counts per health region). Alberta, British Columbia, and Saskatchewan boundary files constituted the base layer of all maps. Separate layers were joined and viewed collectively. Techniques and guidelines presented in Slocum (73), Campbell (70) and Robinson et al (71) were applied.

Thematic maps were constructed to examine the spatial patterns in the data including the clustering of patients in geographic areas. First, dot maps were constructed to examine the spatial distribution of the surgical patient population across the three provinces. Given that several patients resided at the same postal code, graduated circles were used to depict the number of patients per postal code location. The number and proportion of patients who attended the preoperative assessment clinic were mapped. Larger circles were employed to indicate greater number or proportion of patients at a particular postal code location. Darker shades were used to indicate a larger number or proportion of patients per area. Methods suggested by Slocum (73) were used to select symbol styles, sizes and colors for all maps. An iterative process of data exploration, map construction, and map assessment was undertaken throughout the analysis.

Buffer analysis was undertaken to assess patient geographic access to the preoperative assessment clinic. A new map layer was constructed using the Foothills Hospital postal code location as the centre of the buffer zone. Fifty-kilometer straight-line buffer zones that extended outward from the Foothills Hospital were drawn. The distance categories selected for this study matched those constructed in the Study I (refer to

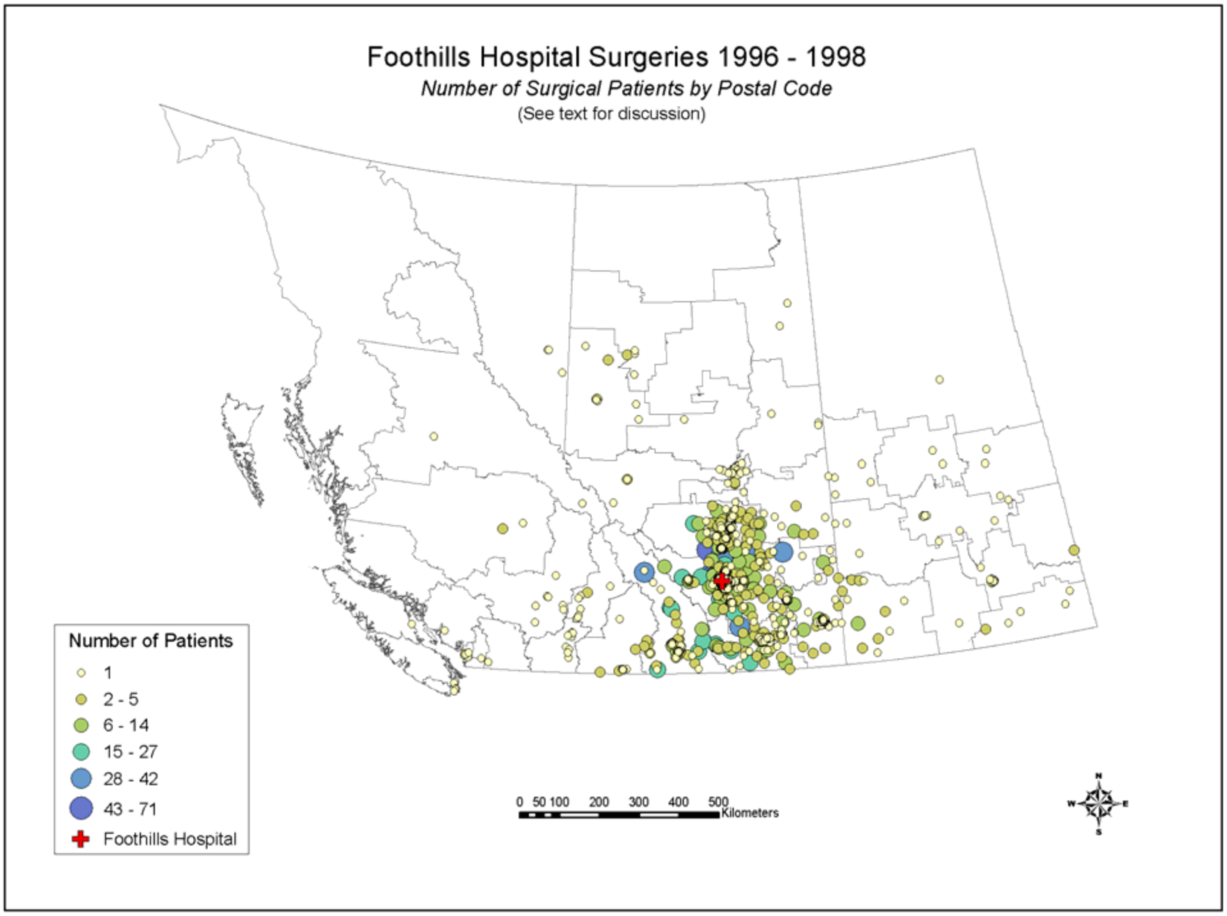
Chapter 4). A layer of major cities and towns was added to provide reference points within each province. Several overlays containing all surgical cases and patients who attended the preoperative assessment clinic were added. The resulting spatial overlays were used visually to inspect patient place of residence and geographical distance from the preoperative assessment clinic located at the Foothills Hospital site.

5.3 Results and Discussion

Over 75 thematic point and area maps of differing scales and information were constructed through the cartographic visualization process, of which seventeen are described and discussed in this section. The selection of maps to present in this thesis is based on several factors. First, the cartographic visualization process resulted in the construction of many more maps then required because of overlapping content and similar methods. Second, maps were selected that best depicted the spatial phenomenon of interest. Third, maps that depicted common mistakes often made by novice researchers who may be unfamiliar with tested cartographic techniques were included. These maps were contrasted against more informative and less misleading maps to demonstrate the need for awareness of applying appropriate methods given the type of data. Visual analysis began with the construction of small scale maps that displayed the distribution of Foothills Hospital surgical patients across the provinces of Alberta, British Columbia and Saskatchewan, and then moved to more complex and larger scaled maps to explore geographic access to the preoperative assessment clinic. Each of the following maps is described in terms of the information that portrayed and is critiqued with regard to the usefulness of the information for the study purpose.

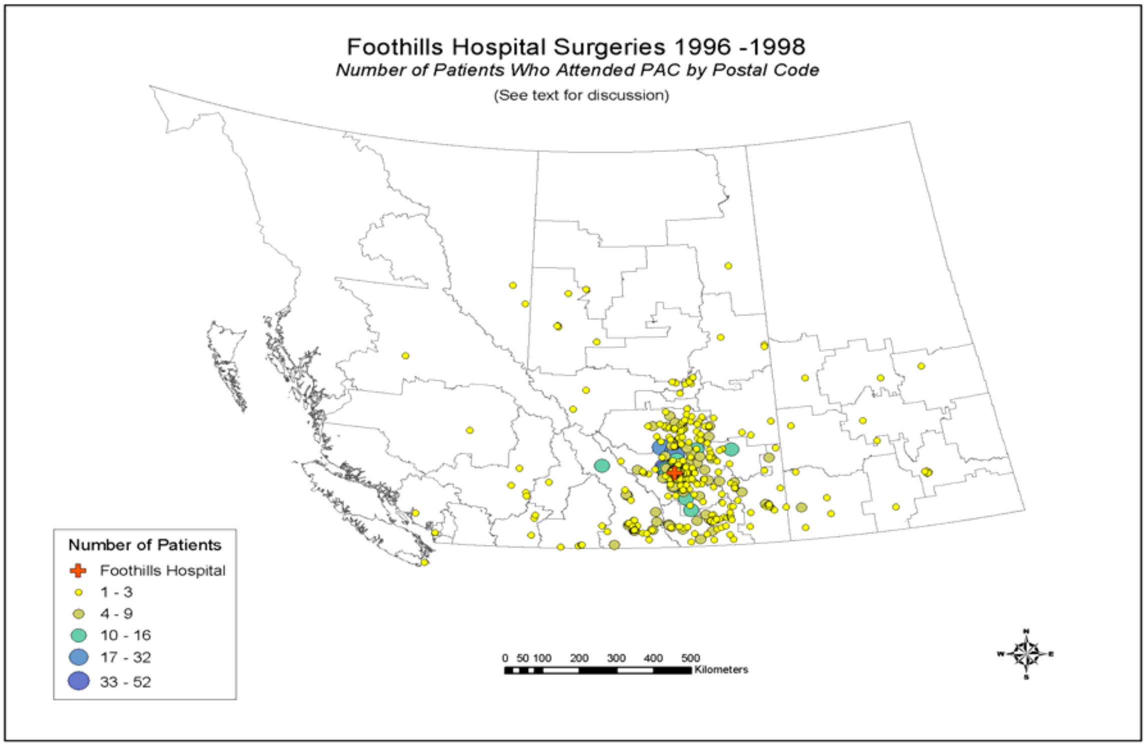
Maps 1 to 5 constitute the initial maps that were constructed. Map 1 shows that surgical patients who underwent surgery at the Foothills Hospital are widely dispersed across the three provinces but that the largest portion of the surgical population tends to live in the southern regions of Alberta and southeastern area of British Columbia (East Kootenay Health Region). Graduated point symbols are appropriate for displaying the raw number of patients per postal code, but the heavy clustering of points in the south-central areas of Alberta limit interpretation. Zoomed-in maps are presented later in this section.

Map 1. Number of surgical patients by postal code

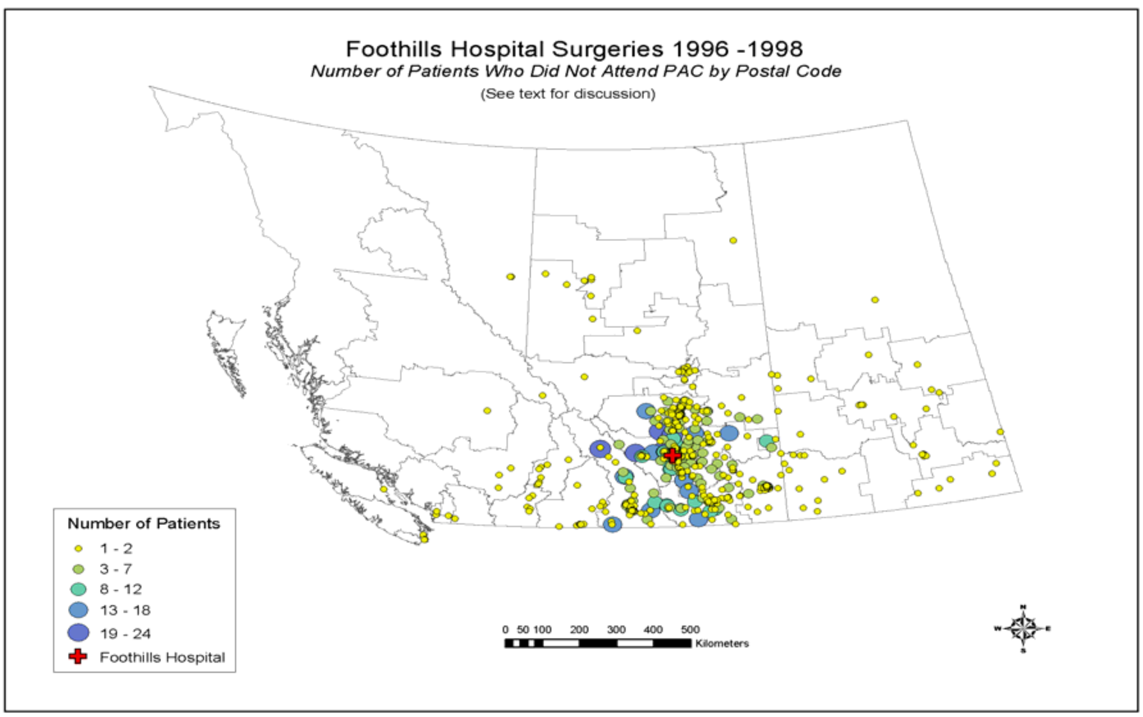


The next two maps display the number of patients who attended the preoperative assessment clinic (Map 2), followed by the number of patients who did not attend (Map 3). The interpretation of Map 2 is problematic because it suggests that only a few patients attended preoperative assessment clinic (i.e. the smallest yellow dots visibly dominate the map). Yet the results from Study I indicate that 59% of all Foothills Hospital surgical patients utilized the preoperative assessment clinic prior to their surgery. Map 3 suggests that a greater number of patients who live outside of the Calgary Health Region did not attend the preoperative assessment clinic compared to patients living closer (e.g., appearance of a larger number of blue dots in areas surrounding Calgary).

Map 2. Number of patients who attended the PAC by postal code



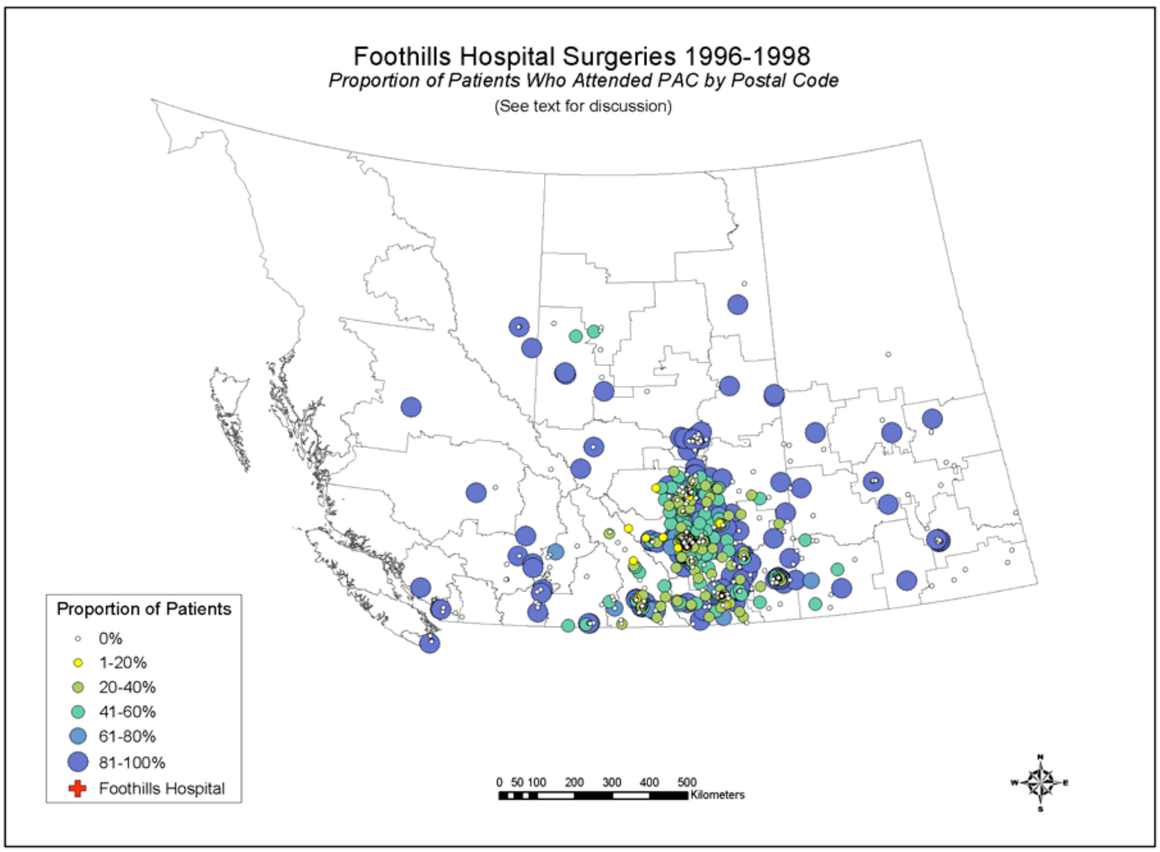
Map 3. Number of patients who did not attend the PAC by postal code



The information provided in the two maps on the page above is limited in several ways. First, the heavy clustering of points in the area immediately surrounding the Calgary Health Region limits the reader's ability to visualize any potential patterns within those areas. Second, while raw numbers are appropriate for point symbols, drawing conclusions from a subset of data extracted from the entire data set (e.g., examining only the number of patients who attended) can lead to misinterpretation. Mapping proportions or rates would be more appropriate.

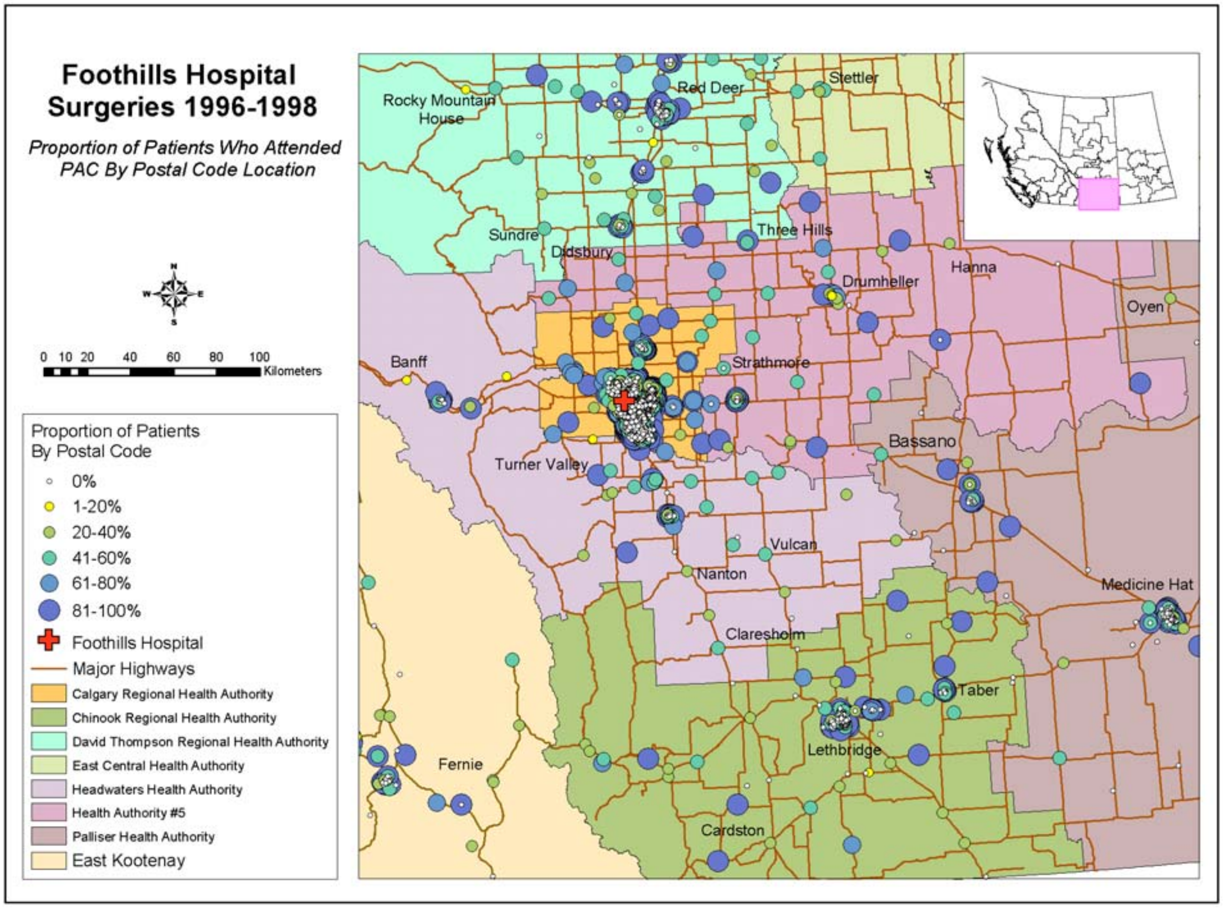
Maps 4 and 5 maintain the use of point symbols to display patient attendance at preoperative assessment clinic, but in this instance, point symbols were used to represent the proportion of the surgical population who utilized the preoperative assessment clinic.

Map 4. Proportion of patients who attended the PAC by postal code



Both maps 4 and 5 suggest that attendance at the preoperative assessment clinic is higher for remote patients than for those who live closer to the clinic. However, the opposite trend was observed in Study I (refer to Chapter 4). This misrepresentation is the result of mapping the proportion of patients who attended without any sense of the size of the denominator (i.e. surgical population) for each point, as well as the heavy clustering of point around the preoperative assessment clinic, making it impossible to discern the number of patients in that area.

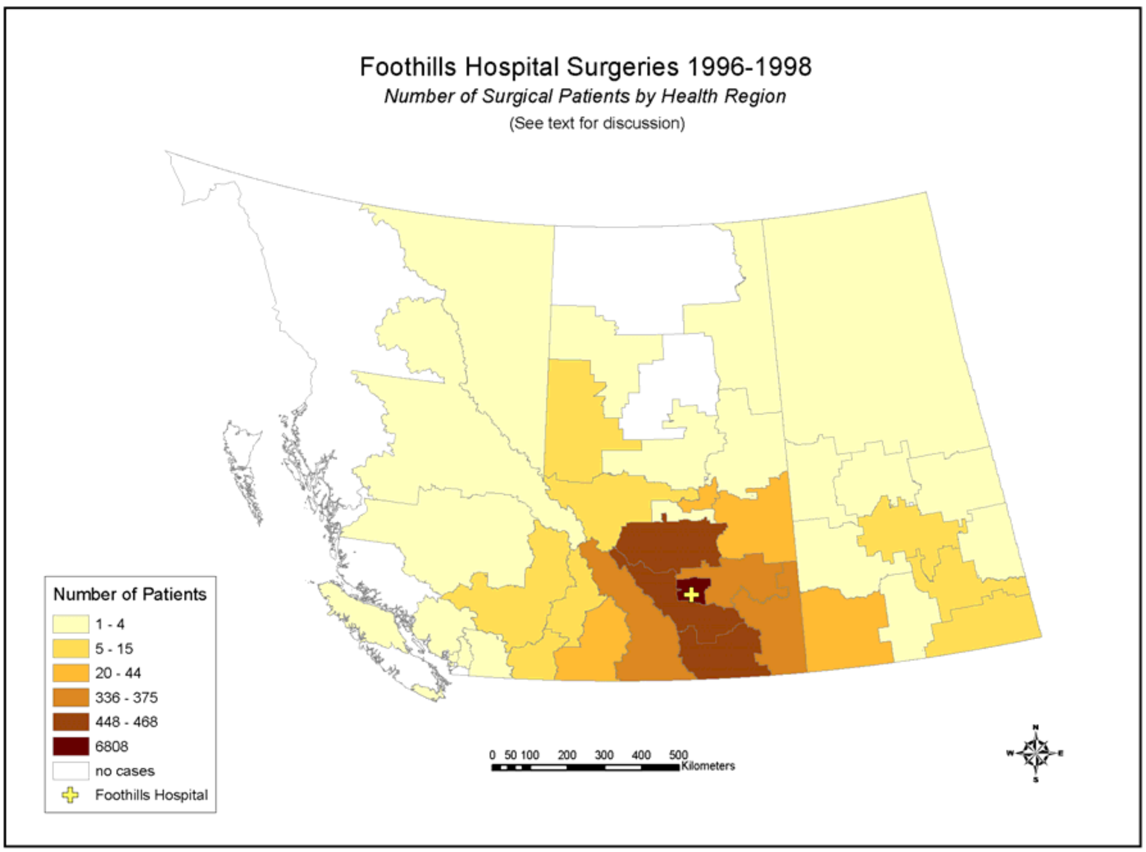
Map 5. Proportion of patients who attended the PAC by postal code



The zoomed-in version in Map 5 portrays the same misleading pattern, but highlights the need to examine a much larger scale map to visualize the data within the city of Calgary. These two maps also demonstrate that while proportions as opposed to raw numbers are appropriate, the choice of point symbols to display this information is not appropriate. As well, the choice of darker colors for larger circles places more visual emphasis on the larger points leading to the perception that these larger points may be more dominant.

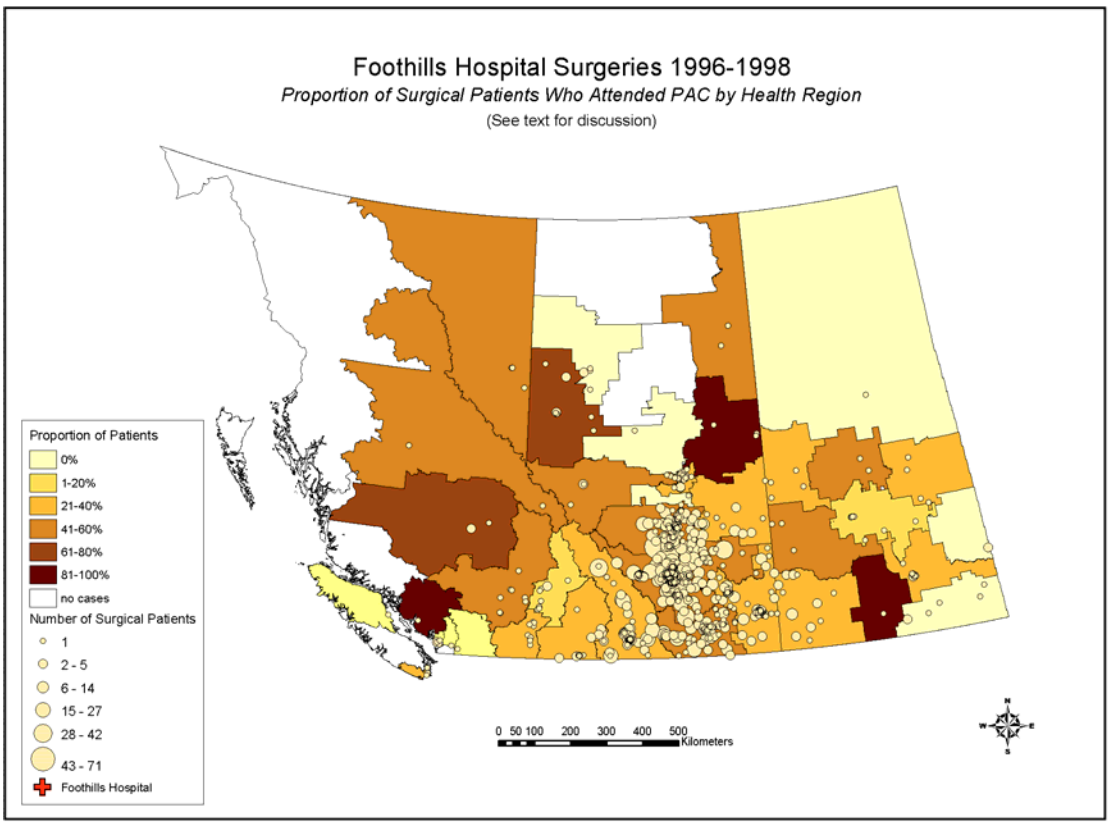
Map 6 introduces the use of area symbols, while Maps 7 and 8 combine both area and point symbols on one map to display the preoperative assessment clinic data. Map 6 displays the number of patients by health region. Health regions were selected as the most appropriate boundaries because the delivery of health services within these units are likely to be similar. Raw numbers displayed as area symbols typically are not recommended since readers tend to perceive areas as proportions or rates (101). In this case however, this map was constructed to examine the distribution of surgical patients by health region. As would be expected, the vast majority of patients in this study live in the Calgary Health Region as indicated by the small dark brown polygon (N=6808). The six health regions that surround the Calgary Health Region constitute the next largest group of patients ranging from 336 to 468. The remainder of the health regions contributes 44 or fewer patients to the surgical patient population. Although not shown on this map, an examination of the types of patients in remote areas reveals that all surgical specialties and patient ages are represented.

Map 6. Number of surgical patients by health region



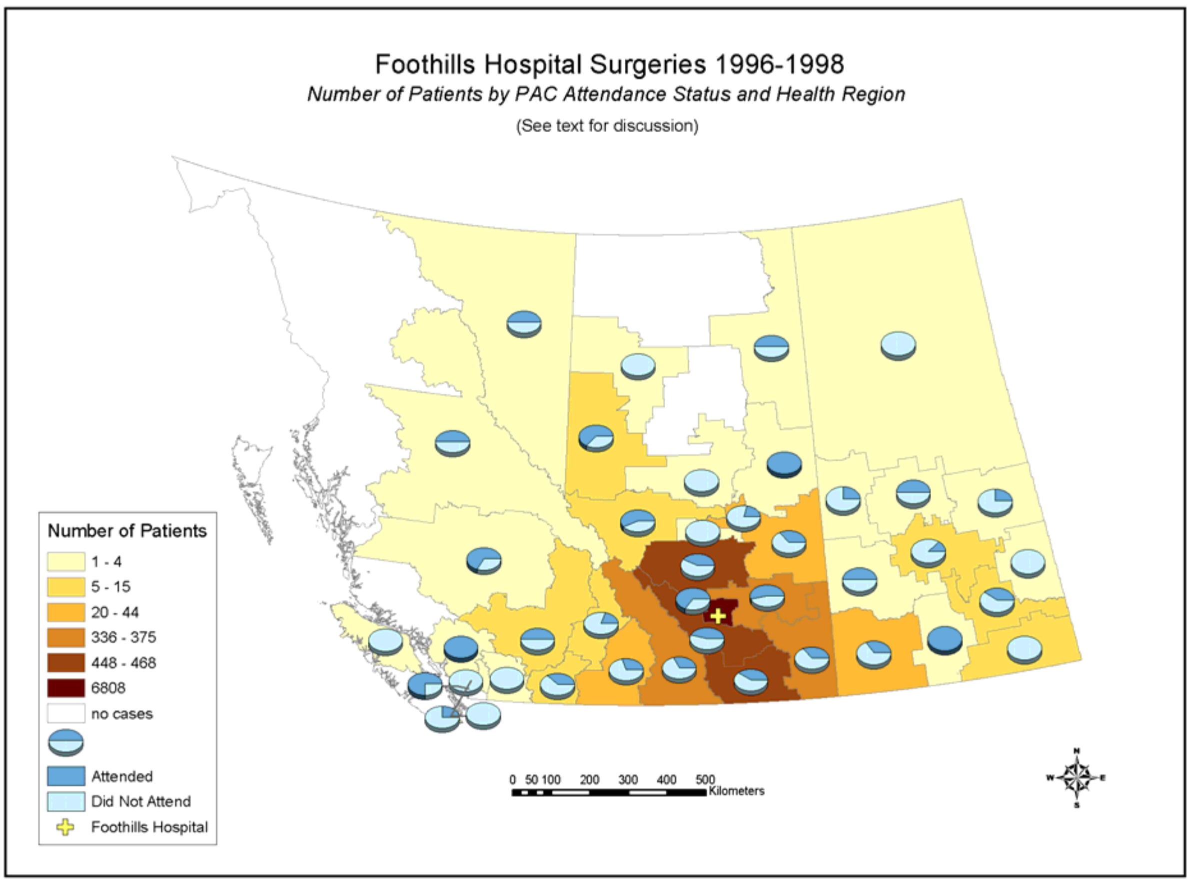
Map 7 was constructed to examine the proportion of patients who attended the preoperative assessment clinic by health region. In this map the health regions were used to represent the proportion of patients who attended. A point layer consisting of the number of surgical patients per postal code was added. The combination of these two layers assists in the interpretation of this map. For example, there are several remote regions that appear to have a high proportion of patients who attended the preoperative assessment clinic. However, when this is examined in conjunction with the point symbols, it is clear that these regions have fewer than 10 surgical patients and therefore caution is required when interpreting patient preoperative assessment clinic utilization for these regions. An examination of the highly populated areas reveals that patients who live further away from the preoperative assessment clinic appear to attend the clinic less often. Similar to the point symbol maps described previously, it is difficult to interpret the map in areas where there are large clusters of points. Hence, a larger scale map of this area is required (refer to Maps 9 to 11 and 15 to 17).

Map 7. Proportion of surgical patients who attended the PAC by health region



Map 8 provides an additional way of examining the same phenomenon observed in the previous map. In this map, pie charts were used to display the actual proportion of patients who attended the preoperative assessment clinic. The pie charts layer was then placed over the base layer that depicts the number of surgical patients per health region. This map is the more useful of the two. The application of pie charts eliminates the need to categorize the proportion data, and the inclusion of the total number of surgical patients per health region provides additional and critical information for interpreting the pie charts. The overall conclusion that can be drawn from this map is that preoperative assessment clinic utilization declines as patient location from this clinic increases. It is noted however that in regions where the patient counts are low, this trend may not be apparent due to the instability of small numbers.

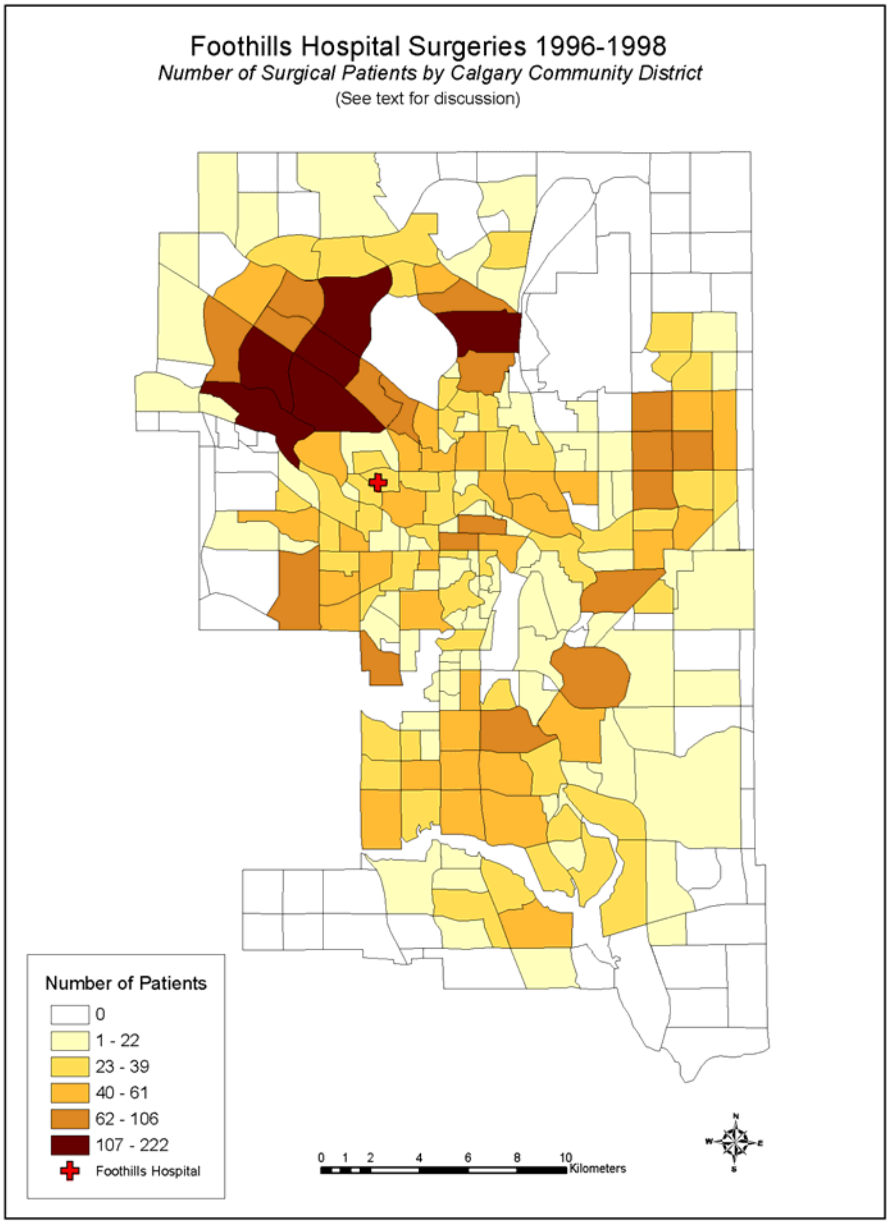
Map 8. Number of patients by PAC attendance and health region



Several city-based maps were constructed in order to explore potential geographic patterns that were obscured by the heavy clustering of points on the previous maps. Map

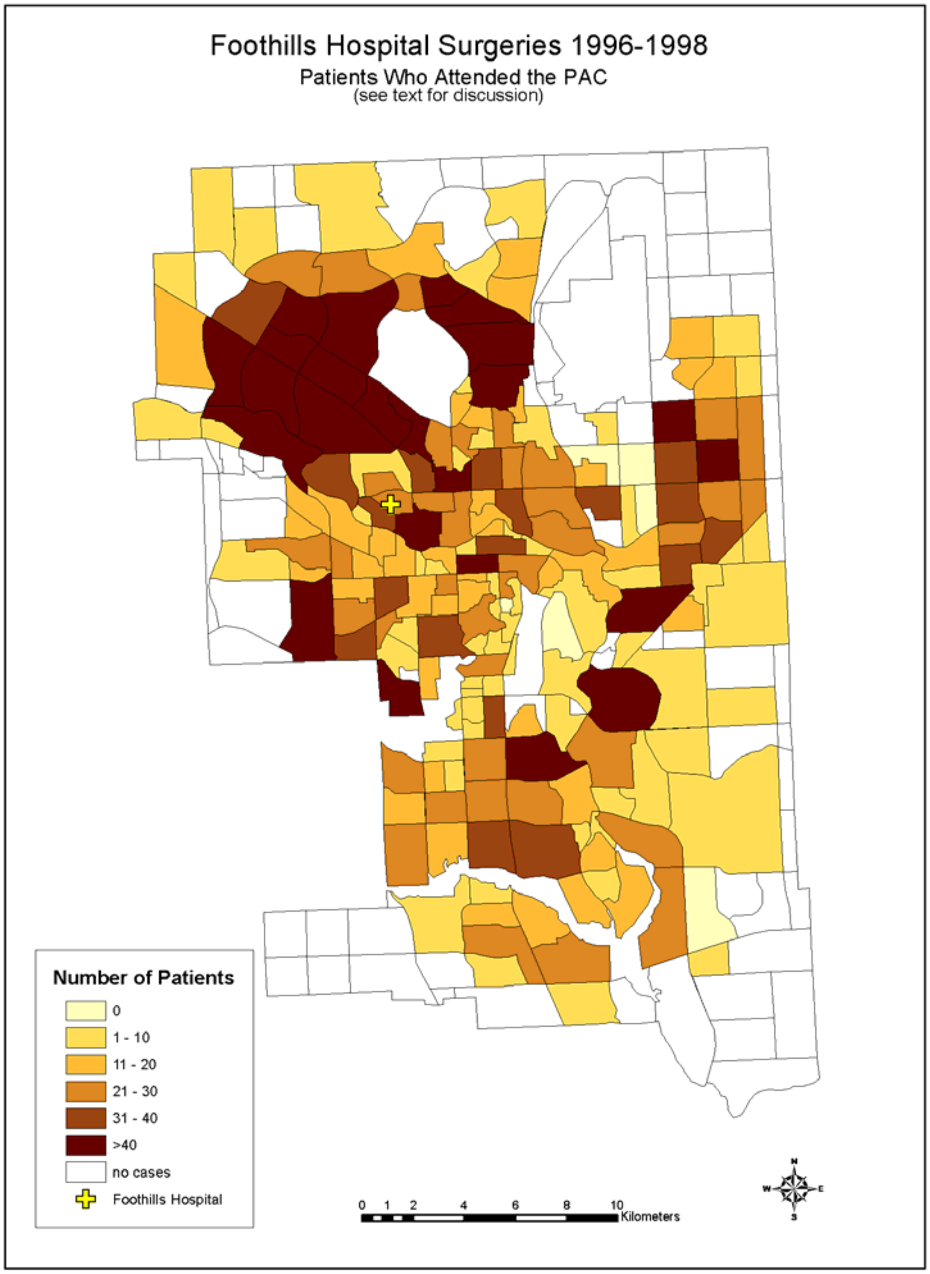
9 displays the distribution of all surgical patients in Calgary by community district. Initially, the number of patients by postal code was mapped (figure not shown) but the information was not interpretable because of the high volume of postal codes within the city boundaries. Next, the number of surgical patients per community district were plotted, recognizing the limitations of area symbols to represent raw numbers. Map 9 below, shows the expected result that the highest numbers of patients who undergo surgery at the Foothills Hospital tend to live in the northwest quadrant of the city.

Map 9. Number of surgical patients by Calgary community district



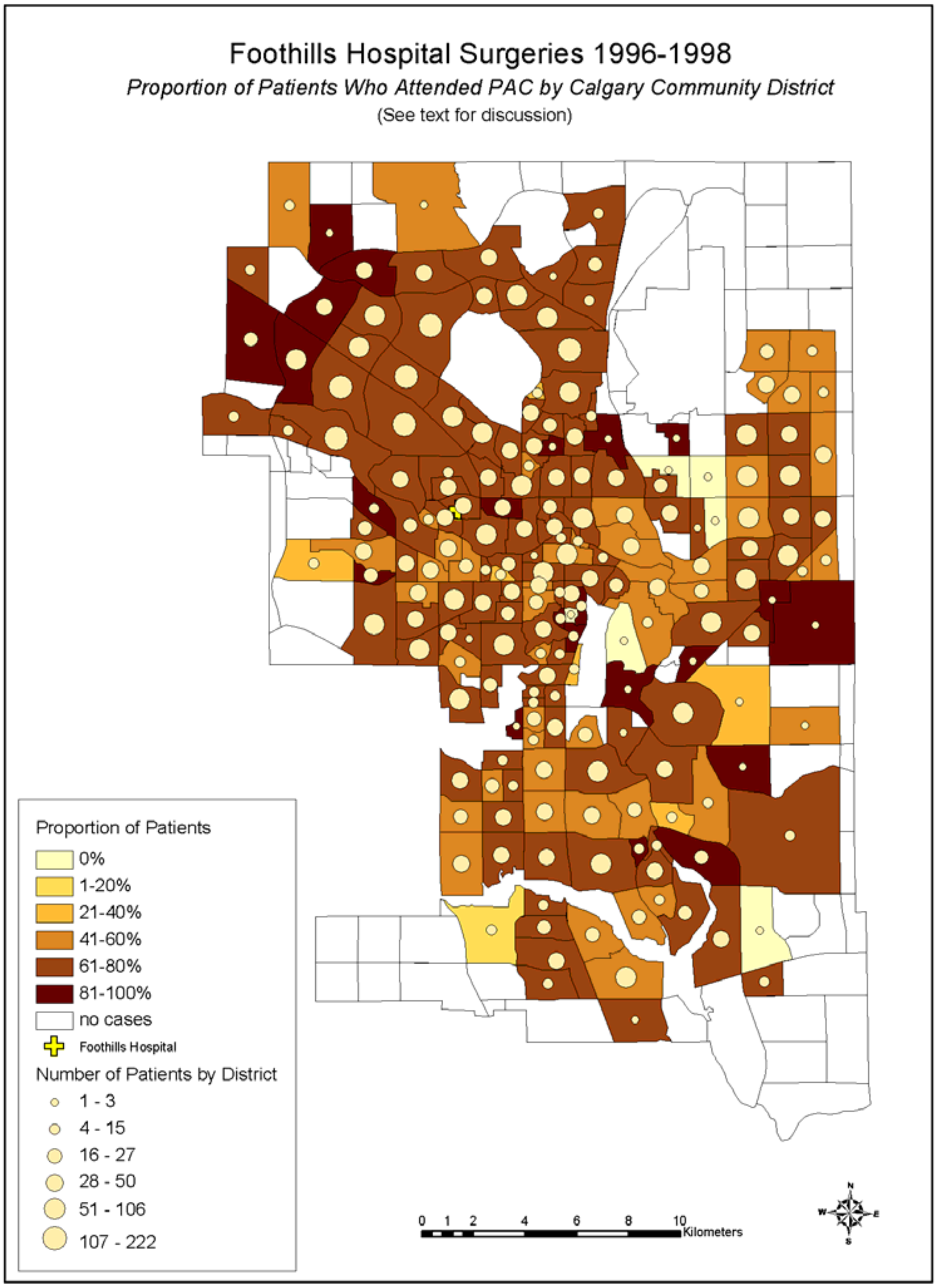
Map 10 displays the number of patients who attended the preoperative assessment clinic by city community. This map provides an example of an inappropriate use of area symbols to present raw numbers. When this map is contrasted against Map 11 two very different patterns emerge. Map 10 incorrectly suggests that there are definite communities across Calgary where preoperative assessment clinic utilization is much higher than in other communities.

Map 10. Number of patients who attended the PAC by community district



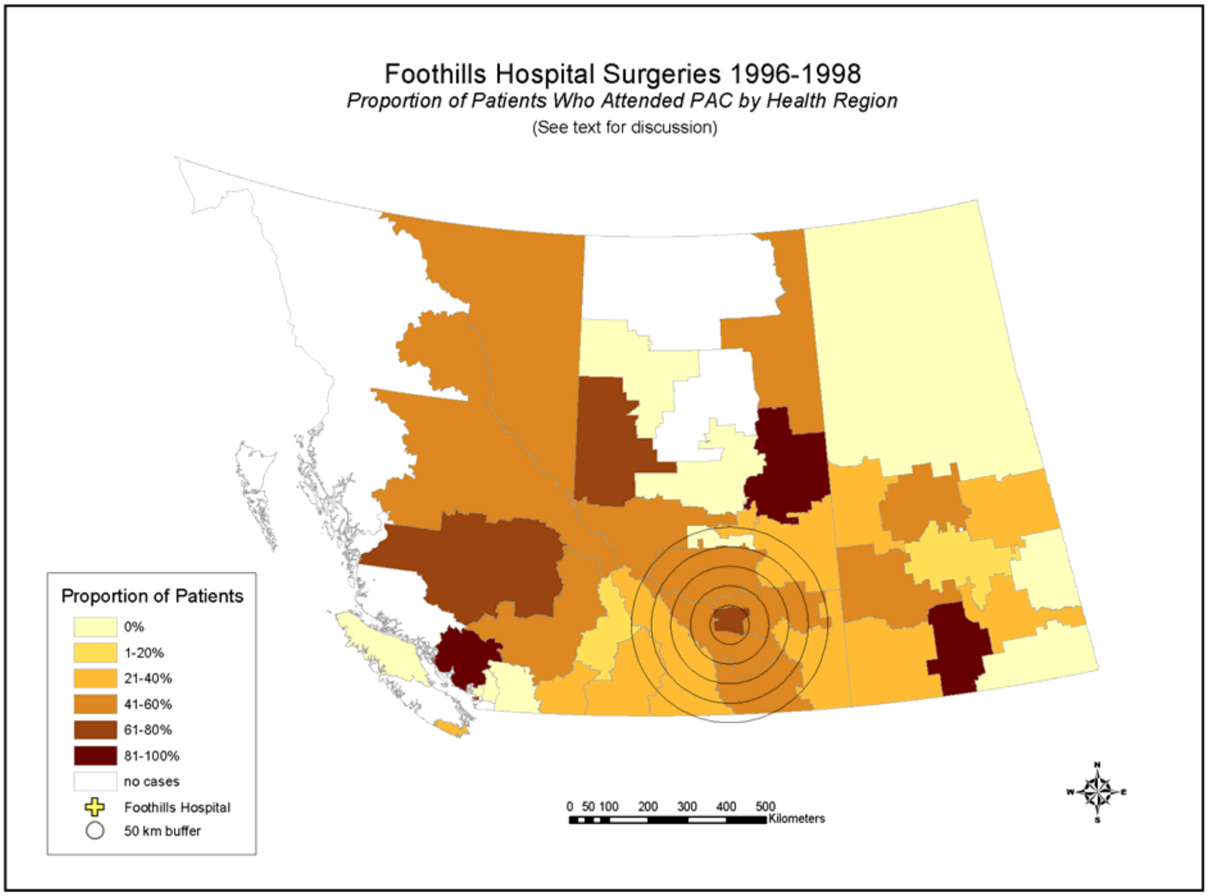
Alternatively, Map 11 demonstrates that patient attendance at the preoperative assessment clinic is relatively uniform across the city and may be slightly lower for patients living in the northeast and southern quadrants of the city. Once again, the inclusion of point symbols to represent the number of patients per community provides critical information for interpreting the observed pattern.

Map 11. Proportion of patients who attended the PAC by Calgary community district



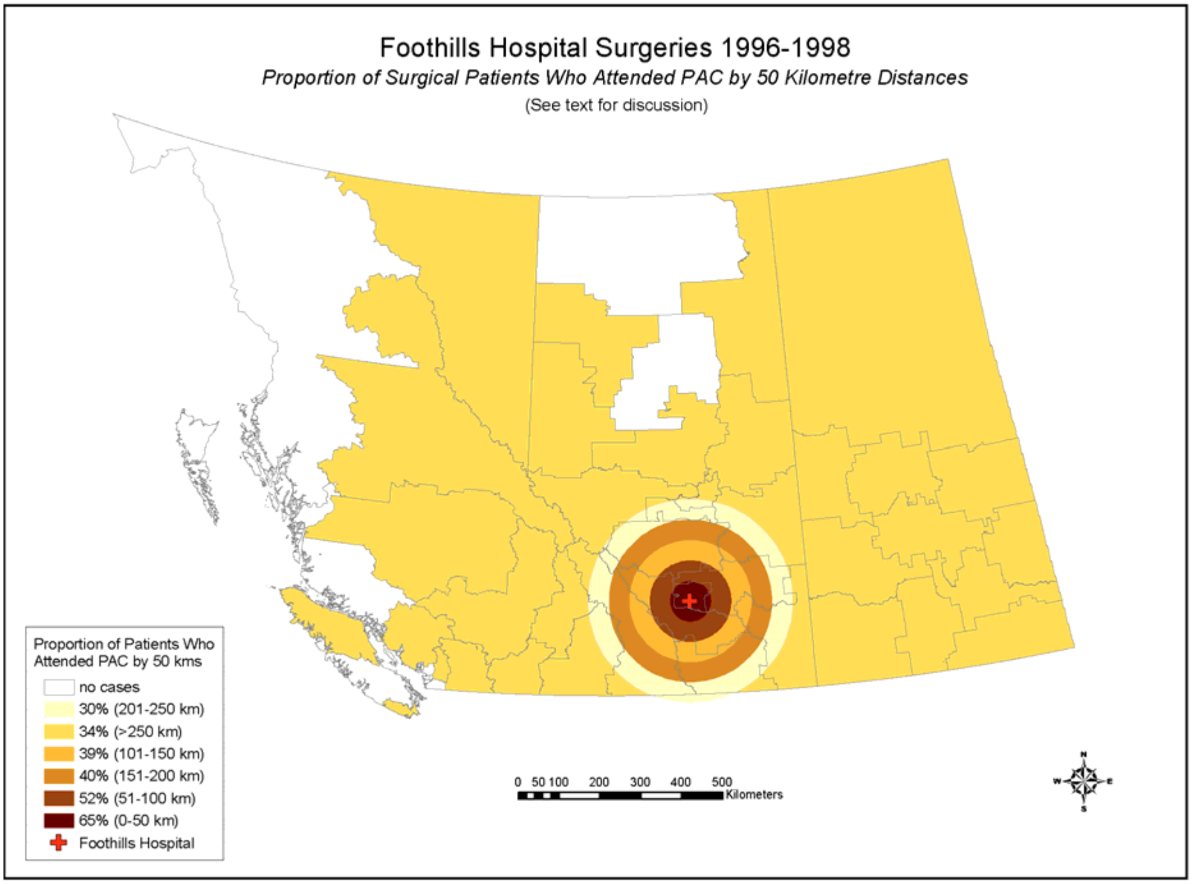
As a means of visualizing the distance analysis conducted in Study I (refer to Chapter 4) several maps of various scales were constructed. Buffer analysis was used to mimic the straight-line distance categories calculated in the first study. Map 12 presents the proportion of patients who attended the preoperative assessment clinic by health region. A 50 kilometer buffer overlay was centred on the Foothills Hospital. This map reveals the health regions and the respective utilization rates that constitute each distance category when patient attendance is based on health region categorization.

Map 12. Proportion of patients who attended the PAC by health region



Maps 13 and 14 present the proportion of patients who attended the preoperative assessment clinic by 50 kilometer distance categories as calculated in Study I. Map 13 clearly shows that as distance from the preoperative assessment clinic increases, patient attendance decreases. Of note however, this map shows that the decline in patient attendance does not decrease in a continuous manner as distance from the preoperative assessment clinic increases. For example, the 3rd ring indicates that preoperative assessment clinic utilization is lower than the 4th ring, when the opposite would be expected. The same is apparent for the two outer rings. After a closer examination of the data, it could be argued that the proportion of patients who attended the preoperative assessment clinic for the 101-150 km (3rd ring) and 150-200 km (4th ring) distances could be combined into one group since the differences between the two categories are very small. The same could be argued for the two furthest distance categories.

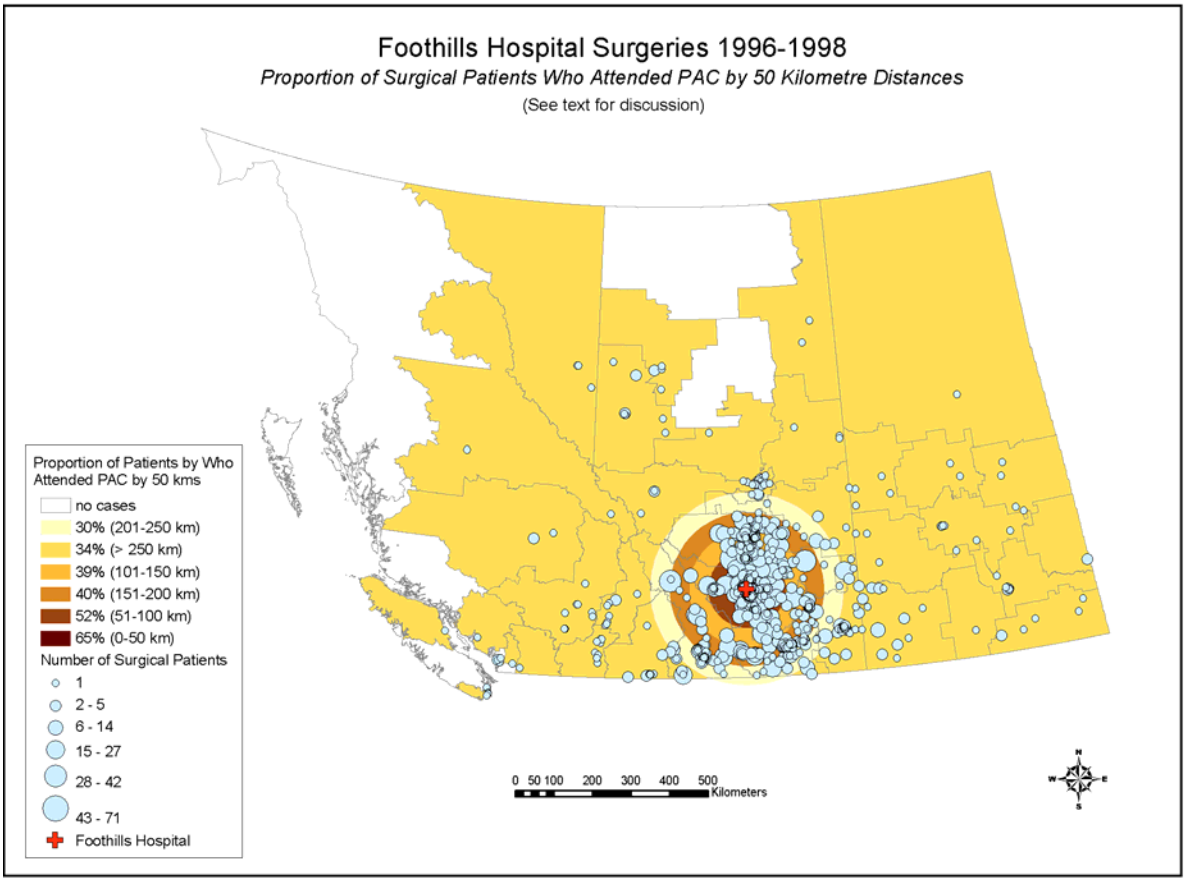
Map 13. Proportion of patients who attended the PAC by 50 kilometre distances



Map 14 on the following page provides additional point information on patient location. The outer rings of the buffer zones show that the patient population is not evenly disbursed throughout each ring. As well, the further distances cover a greater area yet the total number of surgical patients per distance group (excluding the Calgary Health Region) remains relatively stable, indicative of a decreasing surgical population as distance from the Foothills Hospital increases. This map clearly demonstrates the wide geographic spread of surgical patients that make up the >250 kilometre distance group.

The heavy clustering of points near the inner rings of the buffer zone indicates the need to construct a larger scale map in order to examine the geographic patterns in these areas (refer to Maps 9 to11 and Maps 15 to 17).

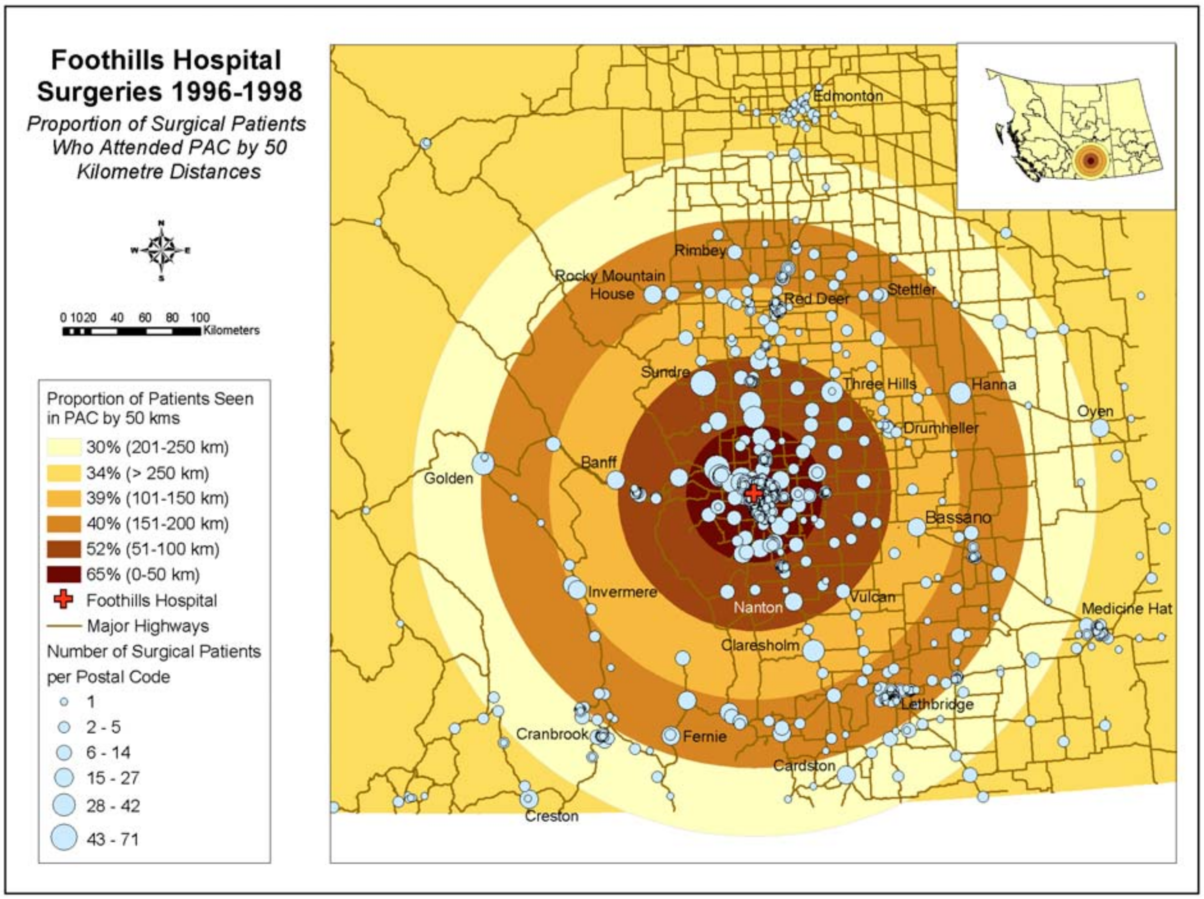
Map 14. Proportion of patients who attended the PAC by 50 kilometre distances



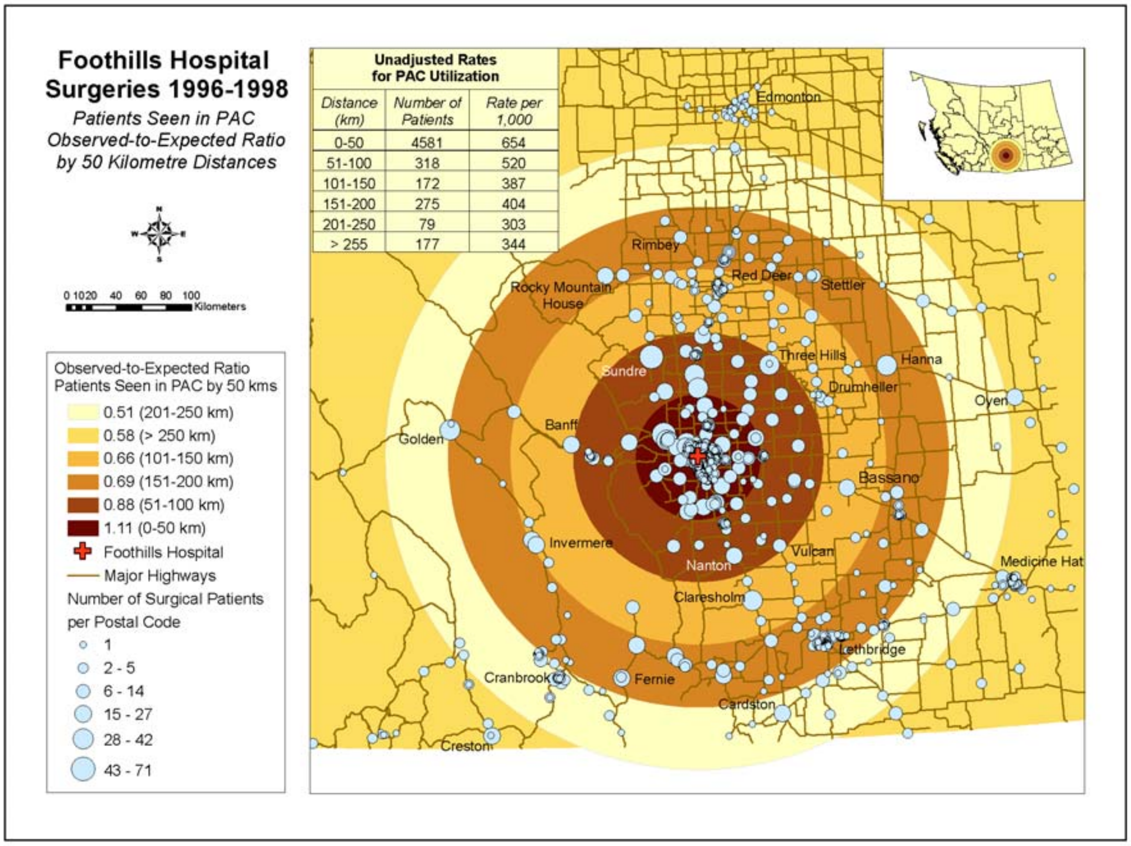
Maps 15 and 16, presented on the following pages, provide a zoomed-in view of Maps 12 to 14. These maps more clearly show the location of surgical patients in each distance category and provide a sense of the roadways that patients likely use to travel to the preoperative assessment clinic. For example, the 201-250 kilometre distance category is comprised of patients who either reside in the most southeastern part of British Columbia (e.g., Cranbrook area), or south and southeastern areas of Alberta (e.g., Cardston). Alternatively, patients in the 101-150 kilometre distances are more evenly disbursed throughout Alberta with the exception of the western side of the province. Map 16 displays similar information but presents patient utilization of the preoperative assessment clinic in terms of the observed-to-expected ratios. For example, in the 151-

200 kilometre distance category, the observed number of patients who utilized the preoperative assessment clinic was 275, resulting in a crude rate of 404 per 1000. Given that the overall crude rate of patient utilization was 589 per 1000, 401 patients would be expected to attend the preoperative assessment clinic in the 151-200 kilometre group, resulting in an observed-to-expected (O:E) ratio of 0.69. This map also provides an example of the usefulness of combining data in a table format on a map.

Map 15. Proportion of patients who attended the PAC by 50 kilometre distances

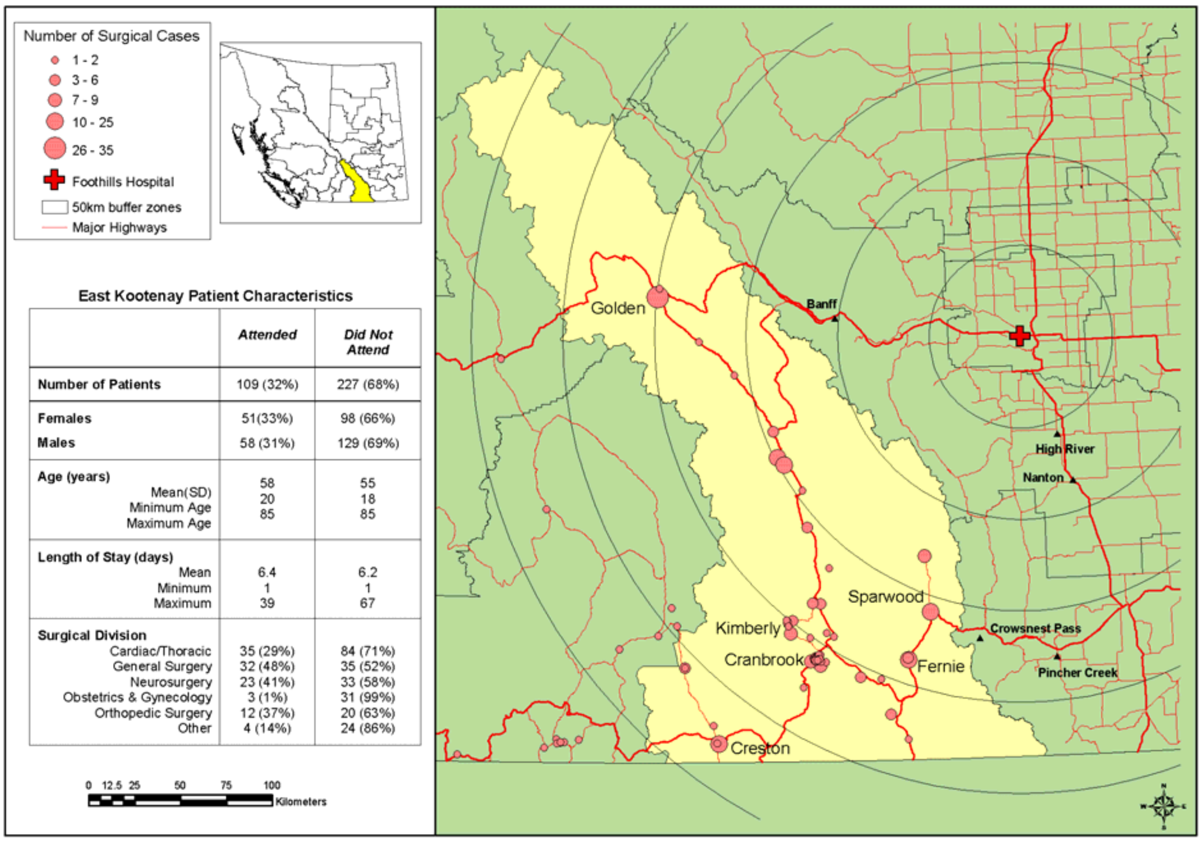


Map 16. Patients seen in the PAC: observed-to-expected ratio



Map 17 on the following page was constructed primarily for two reasons; first to more closely explore the East Kootenay Health Region patient group and second to visually inspect whether straight-line distance is an appropriate distance proxy measure for patients living in this region. A spatial join procedure in ArcGIS was used to extract the patient group who lived within the East Kootenay Health Region polygon. This resulted in a searchable and analyzable dataset. The table inserted on the map describes some of the patient and clinical characteristics of this group (e.g., 336 patients between the ages of 18 to 85, more males, and preoperative assessment clinic utilization was 32%). This map also clearly demonstrates that the straight-line distance calculation (i.e. 50 km buffers) underestimates roadway distance by at least one and sometimes two distance categories. As opposed to Alberta where the roadways are based on a grid-type pattern, the roads in southeastern British Columbia are clearly restricted by geographic barriers such as mountains and lakes. Hence, straight-line distance grossly underestimates the actual road distance that a patient must travel to reach the preoperative assessment clinic. This limitation should therefore be taken into consideration when drawing conclusions about patient travel from this and other regions that are restricted by numerous physical barriers.

Map 17. East Kootenay Health Region - Foothills Hospital surgical patients 1996-1998



East Kootenay Patient Characteristics

	Attended	*Did Not Attend*
Number of Patients	109 (32%)	227 (68%)
Females	51(33%)	98 (66%)
Males	58 (31%)	129 (69%)
Age (years)		
Mean(SD)	58	55
Minimum Age	20	18
Maximum Age	85	85
Length of Stay (days)		
Mean	6.4	6.2
Minimum	1	1
Maximum	39	67
Surgical Division		
Cardiac/Thoracic	35 (29%)	84 (71%)
General Surgery	32 (48%)	35 (52%)
Neurosurgery	23 (41%)	33 (58%)
Obstetrics & Gynecology	3 (1%)	31 (99%)
Orthopedic Surgery	12 (37%)	20 (63%)
Other	4 (14%)	24 (86%)

East Kootenay Health Region
Foothills Hospital Surgery Patients 1996-1998

5.4 Conclusion

The maps constructed in the current study provide a powerful complement to the quantitative statistical analysis presented in the first study (i.e. Study I, Chapter 4). These maps reveal several important spatial characteristics about the data that could not be obtained through regression analysis methods. For example, it was observed that the geographic location of the surgical population of the Foothills Hospital is primarily concentrated in the Calgary Health Region (CHR). The remainder of the population (i.e. approximately 25% of the surgical patient population) is disbursed across the three provinces, with the vast majority of these patients living in one of the health regions that border the CHR. The exception to this is the patients who live in the East Kootenay Health Region in southeastern British Columbia. It was also easy to observe that as patient distance from the preoperative assessment clinic increased, utilization of the clinic decreased (refer to Map 8), and to identify the rural communities that were contained within the specific distance categories (refer to Maps 15 and 16).

Cartographic visualization was also useful for revealing that straight-line distance may be a reasonable method for calculating distance for most areas in central and southern Alberta, but far less appropriate for application in geographic areas such as southeastern British Columbia where there are numerous physical barriers like mountains and lakes (e.g., Map 17). Alternative methods for calculating distance, such as roadway distance or travel time, would be more accurate and likely result in the reclassification of numerous patients in this study into different distance categories. This issue requires further research. For example it would be useful to examine whether there is an increase in the degree of error embedded in a straight-line distance calculation, compared to roadway distance calculation, as distance from the health service increases (e.g., larger error in more remote areas than in closer more densely populated areas). Several researchers have concluded that straight-line distance is a reasonable measure in many cases, demonstrating a high correlation between drive time or road distance, and straight-line distance (67,92,97,98,102). However, these studies were limited to densely populated areas and restricted to relatively short distances (e.g., 100 miles or less). This limitation is important given the centralization of many health services in Canada and the wide geographic spread of the population who seek these services. For example one-third of Alberta's population resides outside of the two major metropolitan areas of Calgary and Edmonton. In addition to exploring roadway distances, other impedances such as time of day and time of year of travel could be explored.

The application of cartographic visualization and this study's use of maps served as one method for examining the spatial relationship between patient place of residence and preoperative assessment clinic utilization. The methods applied in this study were for exploratory purposes and to visually reveal spatial patterns in the data. The preoperative assessment clinic data were examined using both dynamic (e.g., interactive electronic/computer-based maps) and static formats (e.g., paper maps). The dynamic environment facilitated both the data exploration process and the development of the maps. The features and tools in ArcGIS were useful for exploring and revealing aspects of the data that otherwise would have been difficult to ascertain. A wide variety of maps were constructed using different elements such as scales, symbols, colors, hue, etc. This process resulted in the construction of some useful and informative maps, some less than optimal maps, and maps with misleading information. In order to construct informative maps and implement the cartographic visualization processes in an effective manner it is critical to understand the basic principles of cartography and possess the ability to operate GIS software. Many of the processes are complex and access to advanced expertise is required to more fully take advantage of GIS tools and cartographic knowledge. In the current study, the construction of numerous maps partially demonstrates the iterative nature of cartographic visualization. These maps evolved from simple point maps with limited and sometimes misleading information, to more complex and informative displays.

As expected, the cartographic visualization process raised many other questions that are worthy of exploration. For example, it would be interesting to know whether certain patient characteristics such as age and sex influence the distance-utilization phenomenon. Other important questions include whether patients who travel further experience longer hospital stays post-surgery or experience different outcomes (e.g., complication rates). Additionally, a web-based interactive environment that contained the preoperative assessment clinic data could be developed to assist other users address questions that are of importance to them.

The present study had the advantage of using data that were captured at the individual patient level allowing us to explore the data in numerous ways. For instance, individual-level questions such as the geographic location patients could be explored as well as questions that required aggregate forms of the data. Because of this flexibility, the modifiable area unit problem (MAUP) could be explored by creating different size polygons to test whether the observed utilization pattern was due to the size and shape of the polygons or whether the pattern was independent of area size and shape. For example city data were mapped using both community district and census tract boundaries. The preoperative assessment clinic utilization pattern did not change; hence it was concluded that the MAUP was not a concern within the city boundaries maps.

Cartographic visualization provides a powerful method for exploring the spatial aspects of data. Implementation requires a certain level of knowledge and expertise in cartography and GIS software, and the more complex operations/analyses require the input and involvement of experts in these areas. The present study demonstrates the effectiveness of undertaking exploratory spatial analysis and highlights the need for further and more complex study on the distance-health services utilization phenomenon.

CHAPTER 6

STUDY III: SURGEON REFERRAL DECISION-MAKING

6.0 STUDY III: SURGEON REFERRAL DECISION-MAKING

6.1 Background: Physician Referral Decision-Making

Referral behavior is a complex process that involves the interaction among at least three stakeholders in the referral process: the surgeon, the patient, and the family physician (105). Further, the interaction among these stakeholders occurs within a given health care system (see Figure 6.0). Research on the referral of patients to other

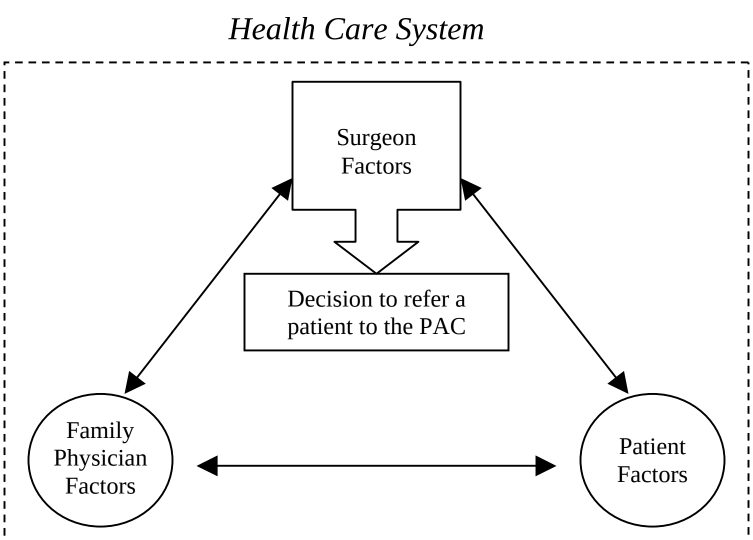


Figure 6.0 Referral decision-making stakeholders

physicians or health services, for the most part, is limited to the identification of rates and patterns of referral (23, 105-106). Further, the majority of studies focus on general practitioner or family physician referrals to medical specialists. Importantly though, these studies reveal that referral rates vary widely among and between physician specialties and across geographical areas, and highlight the possibility of over- and under-referral, all of which have implications for the quality of care (23, 106-108). For example, Bugar et al (23) studied the utilization patterns of a preoperative assessment clinic located at a university-affiliated tertiary care centre. Sixty percent of elective surgery patients were referred to the clinic. Referral varied across surgical disciplines from a high of 72% for general surgery, to a low of 47% for cardiovascular and thoracic surgery. Variation was also noted in the type of consultation that was undertaken at the preoperative assessment clinic. For example anesthesia consultations ranged from 39%

for general surgery patients, to 6% for orthopedic patients. Similar to other studies in the literature, this study did not examine factors that influence surgeon referral decision-making, nor factors related to the geographic location of patients.

Several studies have examined factors involved in a physician's decision to refer a patient. Shortell and Vahovich (109) studied patient and physician related variables involved in the referral process and observed that physician related factors were the most reliable predictors of patient referral rates. This observation was applicable to both surgeons and general practitioners. Likewise, Ludke (105) conducted two studies that examined factors involved in a physician's decision to refer breast cancer patients for further diagnosis and treatment. Ludke (105) categorized these factors into three general decision-making components:

(1) *Technical/care related issues* - quality of patient management, patient results, and individualized patient management and care

(2) *Patient related factors* - convenience to the patient, cost to the patient, patient's potential for productive remaining life, and patient expectations for referral

(3) *Physician related factors* - physician's satisfaction with previous referrals, physician's beliefs about referral, and the attitudes of physician's colleagues and local medical community towards referral

Studies by Ludke (105) as well as Shortell and Vahovich (109) both are important because they identify key factors that influence referral decision-making. However, both studies were conducted on patients with severe illnesses such as cancer, and were undertaken prior to the shared-referral decision making concept in the physician-patient encounter. Further, Watt (110) suggests that decision-making factors for chronic illnesses differ substantially from those that involve illnesses that are life-threatening

Donohoe et al (111) examined family physician referral of patients to medical specialists, and observed that referral decisions include both medical and nonmedical factors similar to those identified by Ludke (105). In addition, Donohoe et al (111) identified other important factors such as patient education, a reduction in the risk of medical liability, and enhancing the patient's trust in medical judgment. In a similar study, Foster and Tilse (106) examined the referral of brain injured patients to a rehabilitation program, and identified three main domains involved in the decision-making process. Again, these mirrored the domains identified by Ludke (i.e. technical/care related issues, patient related factors, and physician related factors) (105).

Lee et al (113) studied anesthesiologists and nursing referral of surgical patients to an outpatient preoperative anesthesia assessment clinic. Patient-related factors associated with referral included comorbidities, medication use, age, history of anesthetic problems, fitness, obesity, and nature of the surgical procedure. Large variations and inconsistencies in the use of these factors for referral decision-making were noted. This may in part be the result of the small sample size (n=34) of the study.

6.2 Study Purpose

Given the current paucity of information regarding the referral process, particularly factors that influence how and why a surgeon refers a patient to a preoperative assessment clinic, further research in this area is warranted. According to the literature there are three primary stakeholders involved in the referral decision-making process: (1) the surgeon, (2) the patient, and (3) the family physician. Secondary stakeholders include patients' relatives, friends and care-givers. The focus in this study was on surgeon decision-making factors because the literature suggests that physicians constitute the largest influencing component in the referral of patients to health services. Of note, family physicians are not directly involved in the referral process for preoperative assessment clinic. However, this does not rule out their involvement (e.g., as might occur if a patient asked them to get involved in discussions on their behalf), but, generally speaking, they do not directly participate in the referral process. Specifically, this study explored whether factors related to the geographic location of patients are considered important by referring surgeons. The *Behavioral Framework for Health Service Utilization* model and Ludke's three referral components were used to explore medical and non-medical factors that influence patient referral to a preoperative assessment clinic. The health geography domains related to patient location were also considered. These components provide a useful conceptual basis for exploring provider-related (i.e. surgeon) factors.

The specific objectives of this substudy were:

(1) to explore whether factors related to the geographical location of patients, in addition to medical and other non-medical factors, influence a surgeon's decision to refer a patient to the preoperative assessment clinic,
(2) to determine surgeon perceived importance of geographical, medical, and non-medical factors in the referral process, and
(3) to explore whether factors that influence referral to the preoperative assessment clinic differ by surgical specialty.

6.3 Methods

A two-stage process was undertaken to identify geographical, medical, and non-medical factors involved in patient referral to the preoperative assessment clinic. The first stage involved the development of a surgeon questionnaire, and the second stage of the study employed a survey of the surgeons involved in the referral of patients to the preoperative assessment clinic.

6.3.1 Questionnaire Development and Pre-Test

6.3.1.1 Subjects and Sampling

A list of all surgeons who were practicing at the Foothills hospital was constructed. Four surgeons from different surgical specialties were selected from this list based on availability, area of surgical specialty, and familiarity with the researchers. These surgeons were interviewed for the preliminary phase of questionnaire development (i.e. cardiac/thoracic, general, obstetrics/gynecology, and neurosurgery).

6.3.1.2 Procedures

Factors shown to influence surgeon referral decision-making were identified in the literature (refer to Appendix B). These factors were categorized into three general groups: (1) patient medical factors, (2) patient location and non-medical factors, and (3) health system and physician practice related factors. These factors were then used to construct a draft questionnaire that contained both scaled and open-ended questions. A one-hour interview was conducted with each of the four surgeons. Each interview was conducted by two researchers; one non-physician (the PhD candidate) and one physician (the student’s supervisor).

Each surgeon was asked to review the draft questionnaire and provide feedback on the content, layout, and general purpose of the questionnaire. Specifically they were asked to comment on:

(a) clarity of the questions,
(b) whether there were items or factors that should be excluded from the questionnaire,
(c) whether there were important items or factors that were missing and should be included,
(d) the appropriateness of the overall flow, length, style, ease of use, and appearance of the questionnaire,
(e) the scale used to rank the factors (e.g., type and number of categories/subdivisions, as well as ease of use and understanding), and
(f) any other comments or suggestions to improve the questionnaire.

Surgeon comments were documented and the two researchers reconvened immediately after the interview to discuss and summarize the findings.

Saturation was reached at the fourth interview (i.e. no new information was obtained from the final interview). The information obtained through the interview process was used to construct the final questionnaire. Three researchers who were not part of this study’s research team then reviewed this version of the questionnaire. These reviewers checked for typographic errors, other errors, and clarity, prior to distributing the questionnaire to the surgeon population.

6.3.2 Surgeon Questionnaire

6.3.2.1 Subjects and Sampling

The sampling frame consisted of all surgeons credentialed in the Calgary Health Region on January 01, 2005, who had medical staff privileges and practiced primarily at the Foothills Hospital (N=80). A list of surgeons and their contact information was obtained from the Calgary Health Region clinical departments of Surgery, Obstetrics and Gynecology, Cardiac Sciences and Neurosurgery.

6.3.2.2 Survey Instrument

The final questionnaire consisted of a single double-sided page that contained four sections. Sections 1 through 3 were comprised of 51 factors (22 patient medical factors, 15 patient location and non-medical factors, and 14 health system and physician practice related factors). Surgeons were asked to rate each factor using a scale of 0 (not at all important) to 10 (extremely important), on how important they felt that factor was when deciding to refer their patient to the preoperative assessment clinic prior to surgery. The selection of a 10 point scale was based on input from the surgeons interviewed during the questionnaire development phase of this study. The final section of the questionnaire contained questions regarding surgeon practice characteristics such as the number of years in medical practice, location of training, surgical specialty, estimated number of surgeries per year, and referral practices. Surgeons were asked to specify whether there was a distance beyond which they would not ask their patients to travel. Refer to Appendix C for the complete survey.

6.3.2.3 Procedure

A modified version of the total design method (TDM) was used to implement the survey (114). First, the heads of the departments/divisions of surgery, obstetrics/gynecology, neurosurgery and cardiac surgery were contacted (initial contact or prenotice). These leaders were informed of the purpose of the study and asked to participate by encouraging the surgeons in their department/division to complete the questionnaire. Each department/division head wrote a letter of support that contained information on the importance of the study, introduced the researchers and encouraged participation. These letters were included in the survey package. This procedure was implemented because medical peer recruitment has been shown to increase response rates by 10% (115). On the first mailing, each surgeon received a letter of introduction and support from the respective department/division head, an information and instruction sheet from the investigators, a copy of the survey, and a self addressed and stamped return envelop. Identification number markers were used on the questionnaires to track respondents for follow-up mailings. Only one member of the research team had access to the questionnaire numbers and the corresponding list of surgeons. This list was maintained in paper format and filed separately from the study data in order to maintain respondent confidentiality.

Survey packages were sent through the Calgary Health Region internal mail approximately one week after initial contact with the department/division heads. Two weeks after the first mailing, non-respondents were sent a second survey package. This package contained the same contents as the initial mailing, plus a personalized and signed letter from the investigators outlining the importance of the study and thanking respondents for their participation. A third and final mailing for non-respondents was undertaken four weeks later.

Monetary incentives are known to increase the response rates of surveys that involve physicians (116-119). For this reason, surgeons who completed questionnaire were entered into a lottery. Five $100 gift certificates for use at the University of Calgary bookstore were awarded.

6.3.2.4 Data Analysis

Questionnaires received within 10 weeks of the initial mailing were included in the study (see Figure 6.1 on the following page). The data were coded and entered into STATA 8.0 statistical software for analyses (120). Response rates were tabulated for each mailing. Categorical variables were tabulated and continuous variables were examined using histograms and box plots.

Descriptive analysis of surgeon characteristics and responses to scaled items were performed. Scaled items (referral factors) were treated as continuous variables. The mean and confidence interval for each referral factor was calculated by surgical division and overall. The surgical specialties of otolaryngology, transplant and plastic surgery were combined in order to maintain data confidentiality due to the small number of surgeons in each of these specialties. Referral factors were grouped into 3 composite scores: (1) 22-medical factors, (2) 12-patient location factors, and (3) 14-health system/physician practice factors. Composite scores were constructed first by calculating the average of each respondent resulting in a per respondent composite score. Then the average of all respondent composite scores was calculated. Patient anxiety about surgery, social support from family and friends, and previous experience with the preoperative assessment clinic were not included in the patient location composite score, given that these factors are not specifically related to geographical location. Cronbach's alpha was used to test the internal consistency of the factors that made up the composite scores (121). The scores for the composite measures of medical, location and health system/practice were 0.95, 0.97 and 0.91 respectively, indicating that it was reasonable to combine individual factors into their respective composite score (121). Composite scores were compared using the paired t-test, $p<0.05$. Box plots were constructed to examine patient location variables by surgeon sex, whether the surgeon previously lived or practiced in a non-metropolitan location (i.e. population < 50,000), and whether a surgeon would ask their patients to travel to the preoperative assessment clinic regardless of patient distance from the clinic. Differences between groups were assessed using the Student's t-test, $p < 0.05$.

Subgroup analysis of differences between surgical specialties was not feasible given the limited sample size coupled with a relatively large number of surgical specialties in the study. This resulted in a lack of statistical power to make confident assertions in making comparisons, recognizing that the highest risk was a type II error. Given the awareness of this limitation at the beginning of the study, forest plots were constructed to visually compare average responses, thus creating a referral factors profile for each surgical division.

6.4 Results

The overall response rate was 84% (67/80) and ranged from 67% to 100% across surgical specialties. The response rates over the course of the study mailings are shown in Figure 6.1 on the following page.

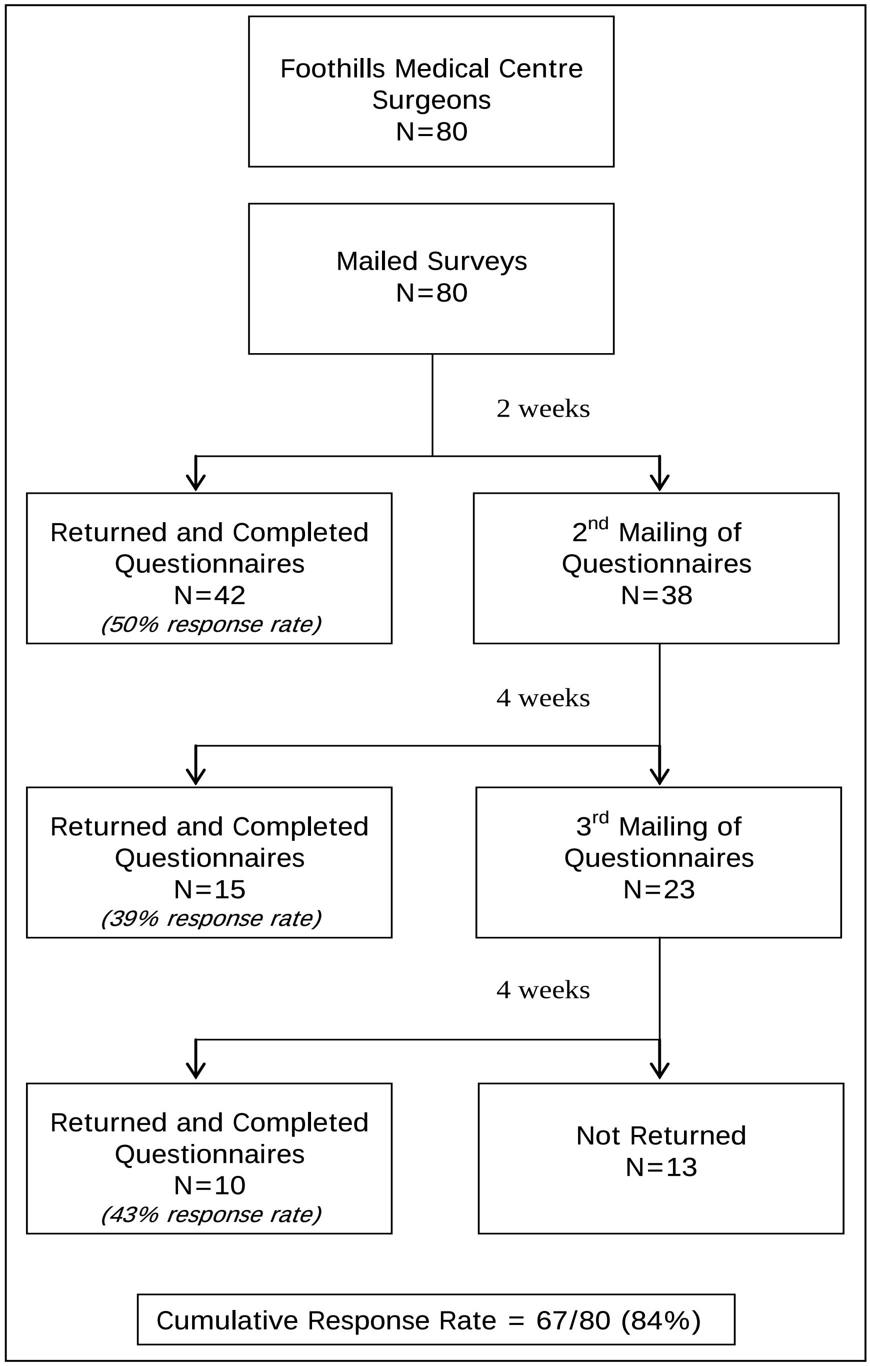


Figure 6.1 Foothills Hospital surgeon response rate

Non-responders (N=13) were represented in all surgical specialties with the exception of thoracic and otolaryngology. Table 6.0 displays the characteristics of the surgeons who responded to the questionnaire. Responders were predominantly male, practicing an average of 10 years in Calgary. For the most part, all surgical divisions were equally represented. Although approximately one third of surgeons lived in a non-metropolitan location (i.e. population < 50,000) at some point in their lives, less than one quarter actually practiced medicine in a non-metropolitan location.

Table 6.0 Survey respondent characteristics

	N (67)	%
Responses by Surgical Division		
Cardiovascular/Thoracic	10	14.9
General	13	19.4
Neurosurgery	11	15.4
Obstetrics and Gynecology	13	19.4
Orthopedics	9	13.4
Other*	11	16.4
Male surgeons	61	91
Lived in non-metropolitan location 1year or more	21	33
Practiced in non-metropolitan location 1 year or more	15	23
	Mean (std dev)	Median
Years since residency training (mean)	15.4 (7.6)	16
Surgeries in the past 12 months (mean)	208 (113)	200
Years of practice in Calgary (mean)	10.9 (8.5)	10
Proportion of patients referred to preoperative assessment clinic in past 12 months	44 (32)	38

* Other includes otolaryngology, transplant and plastic surgical specialties

Surgeons rated the burden of comorbidities, use of anticoagulants, type of surgical procedure, and problems with anesthetic agents as the most important patient medical factors considered when referring a patient to the preoperative assessment clinic prior to surgery. Table 6.1 shows the mean, median, and upper and lower percentiles for the importance scores assigned by surgeons each of the 22 medical factors. The rating scale ranged from 0 (not important at all) to 10 (extremely important).

Table 6.1 Patient medical factors

Referral Factors	Mean	95% Confidence Interval	Median	Lower Range (25th percentile)	Upper Range (75th percentile)
Patient age	6.27	5.60 - 6.93	7	6	8
Burden of Comorbidities					
Cardiovascular disease	8.62	8.02 - 9.22	9	8	10
Pulmonary disease	8.56	7.97 - 9.15	9	8	10
Hepatic disease	7.59	6.96 - 8.22	8	7	9
Endocrine disease	6.86	6.23 - 7.50	7	6	8
Renal disease	7.61	7.00 - 8.21	8	7	9
Cerebrovascular disease	7.64	7.01 - 8.27	8	7	9
Neurological disease	6.62	5.99 - 7.25	7	5	8
Surgical procedure	7.21	6.50 - 7.92	8	6	9
Patient physical mobility	5.18	4.58 - 5.78	5	4	7
Patient obesity	5.50	4.86 - 6.14	6	4	7
Smoking history	4.88	4.30 - 5.46	5	4	7
Alcohol abuse	4.96	4.39 - 5.52	6	3	7
Use of anticoagulants	7.34	6.74 - 7.93	8	4	7
Use of anti-platelets	5.37	4.76 - 5.98	6	6	9
Use of corticosteroids	5.74	5.04 - 6.44	5	5	7
Use of other medications	5.18	3.76 - 6.60	9	5	8
Number of current medications	5.09	4.49 - 5.70	4	4	7
Problems with anesthetic agents	7.92	7.24 - 8.61	9	7	10
Allergies to medications/ environmental agents	3.75	3.16 - 4.34	4	2	5
Mental status	4.55	3.91 - 5.20	5	3	6
Physical status	5.82	5.13 - 6.50	6	4	8

Overall, patient location and non-medical factors were rated 4 or lower on the 10 point scale. Surgeons indicated that patient anxiety about their surgery and whether a patient lived outside of Alberta were the most important patient location and non-medical factors considered in their referral decision (refer to Table 6.2).

Table 6.2 Patient location and non-medical factors

Referral Factors	Mean	95% Confidence Interval	Median	Lower Range (25^{th} percentile)	Upper Range (75^{th} percentile)
Kilometers patient lives from clinic	3.00	2.35 - 3.65	3	1	4
Patient travel time	2.94	2.30 - 3.58	3	1	4
Physical difficulty traveling	3.74	3.09 - 4.40	4	1	5
Requires assistance to travel	3.20	2.57 - 3.83	3	1	5
Mode of transportation	2.83	2.20 - 3.46	2	1	4
Time of year patient must travel	2.71	2.04 - 3.38	2	0	4
Travel weather conditions	3.14	2.44 - 3.84	3	1	5
Patient lives outside of Alberta	4.14	3.32 - 4.96	3	1	7
Patient lives in a rural community	2.57	1.96 - 3.18	2	1	4
Costs related to travel	3.11	2.42 - 3.80	2	1	5
Lodging costs related to travel	3.23	2.53 - 3.93	3	1	5
Lost wages or time off to travel	2.97	2.28 - 3.66	2	1	5
Patient anxiety about surgery	4.51	3.72 - 5.31	5	1	7
Support from family/friends	3.12	2.48 - 3.76	2	1	5

Health system and physician practice factors ranged in importance from 4 to 8 (Table 6.3). Surgeon beliefs about the benefits of the preoperative assessment clinic, consultations with anesthesiology and internal medicine, quality of care, improved care, and the ability to rule out potentially dangerous conditions were rated as the most important system/practice factors considered in the decision to refer a patient to the preoperative assessment clinic.

Table 6.3 Health system and physician practice related factors

Referral Factors	Mean	95% Confidence Interval	Median	Lower Range (25th percentile)	Upper Range (75th percentile)
Physician satisfaction with previous referrals	6.33	5.68 - 6.98	7	5	8
Physician beliefs about the benefits of PAC	7.08	6.42 - 7.74	8	6	9
Colleagues attitudes about PAC	4.12	3.31 - 4.93	4	1	7
Quality of care the patient receives at PAC	7.15	6.46 - 7.85	8	7	9
Reduce the risk of cancellation of surgery	6.91	6.18 - 7.67	8	5	9
Waiting time for PAC appointment	5.60	4.80 - 6.40	5	3	8
Introduce patient to hospital's services	4.83	4.03 - 5.63	5	2	7
Improve patient care	7.69	7.03 - 8.34	8	7	10
Perform a diagnostic test	5.03	4.25 - 5.81	6	2	8
Rule out potentially dangerous conditions	7.25	6.55 - 7.98	8	7	9
Meet a standard of care	6.86	6.21 - 7.49	7	5	9
Consultation with anesthesiology	8.15	7.60 - 8.71	9	8	10
Consultation with internal medicine	7.83	7.17 - 8.49	9	7	10
Consultation with nurse	4.95	4.17 - 5.76	5	2	7

A comparison of the three composite scores (i.e. patient location, health system/physician practice, and patient medical) demonstrates that surgeons consider patient location factors (mean = 3.1, 95% CI 2.5-3.7) as less important than either medical (mean = 6.3, 95% CI 5.9-6.8) or health system/practice factors (mean = 6.4, 95% CI 5.9-6.9), ($p < 0.001$ for the difference in scores across the three categories), in deciding whether to refer a patient to the preoperative assessment clinic.

The surgical profiles displayed in the figures on the next two pages indicate that mean composite scores do not vary, or vary slightly across surgical specialties (Figures 6.2 to 6.4). For example, the mean patient medical composite scores range from 6 to 7 for all surgical specialties, with the exception of cardiovascular/thoracic surgery. Similarly the mean composite scores for patient location range between 2.5 to 4 for all surgical specialties, while the mean health system/practice composite scores range from 5.0 to 7.5.

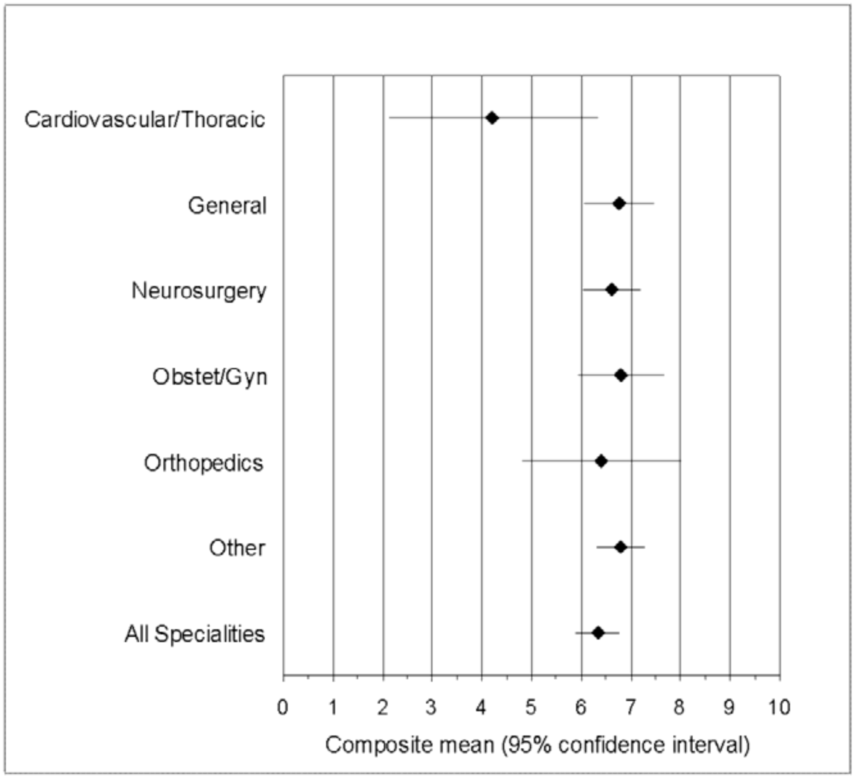


Figure 6.2 Patient medical composite score by surgical specialty

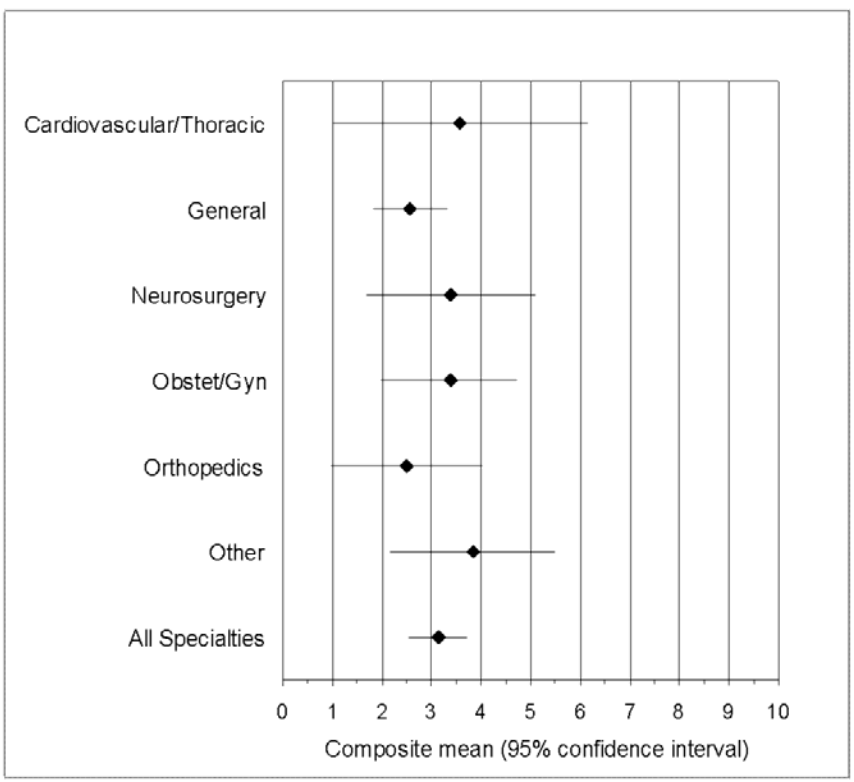


Figure 6.3 Patient location composite score by surgical division

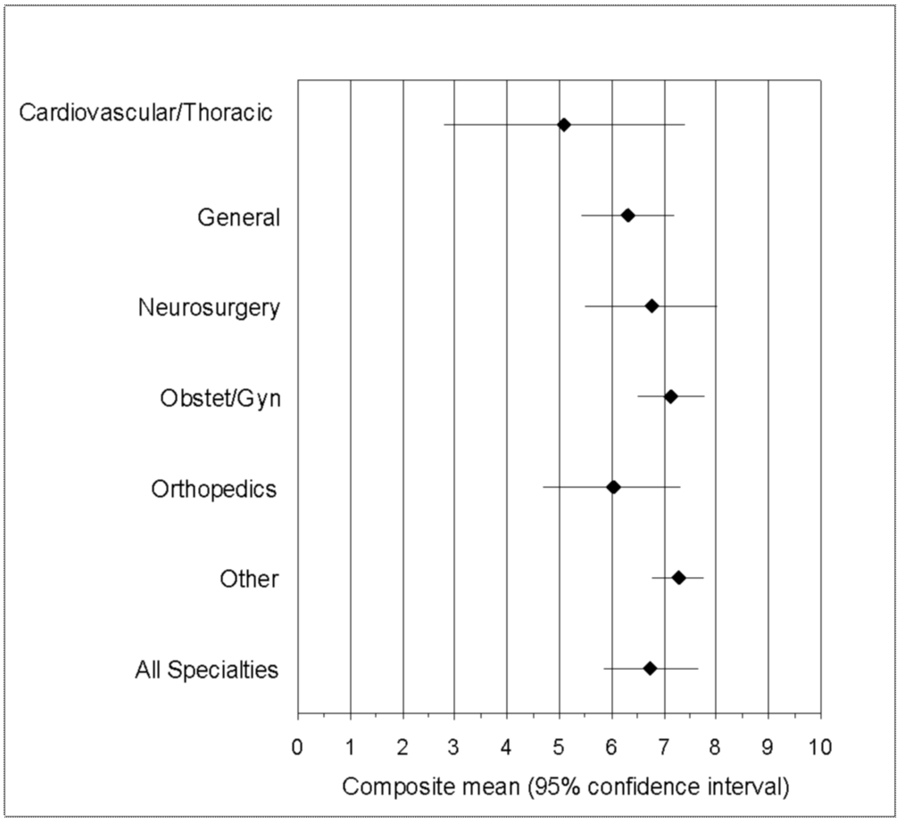


Figure 6.4 Health system and practice related composite score by surgical specialty

There were no differences in mean patient location composite score for surgeon sex, whether a surgeon lived or practiced in a non-metropolitan area, or whether a surgeon would ask their patient to travel to the preoperative assessment clinic regardless of where the patient lived (see Figures 6.5-6.6 on the following page). For example, in Figure 6.5, the importance of patient location was scored slightly higher for female surgeons (mean = 3.56, 95% confidence interval = 1.08 - 6.05) compared to male surgeons (mean = 3.10, 95% confidence interval = 2.48 - 3.71) (p = 0.67), but was not statistically different. Further, the wide confidence interval for the female composite score encompasses the confidence interval for the male surgeons. This likely reflects the small number of female surgeons (N = 5) compared to male surgeons (N = 61) in this study.

Again in Figure 6.6, the mean composite score for patient location did not differ according to whether a surgeon lived in non-metropolitan area for one year of more (i.e. mean score for whether a surgeon lived in a non-metropolitan location = 2.63, 95% confidence interval = 1.73 – 3.53 versus did not live in a non-metropolitan location = 3.37, 95% confidence interval = 2.61 - 4.12) (p = 0.24).

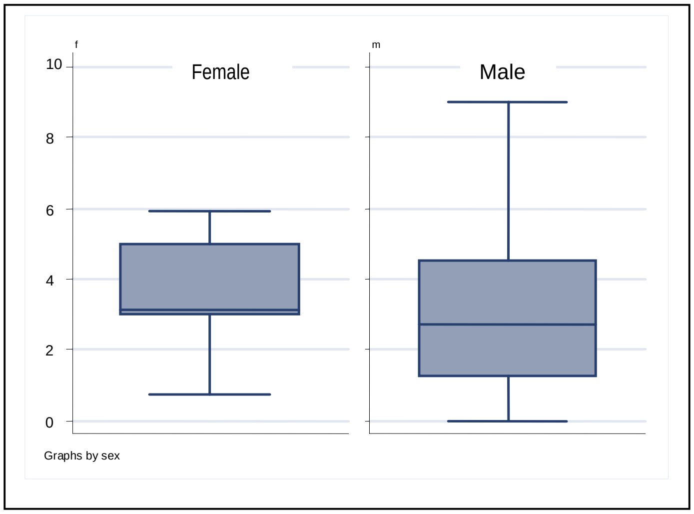


Figure 6.5 Importance of patient location by surgeon sex

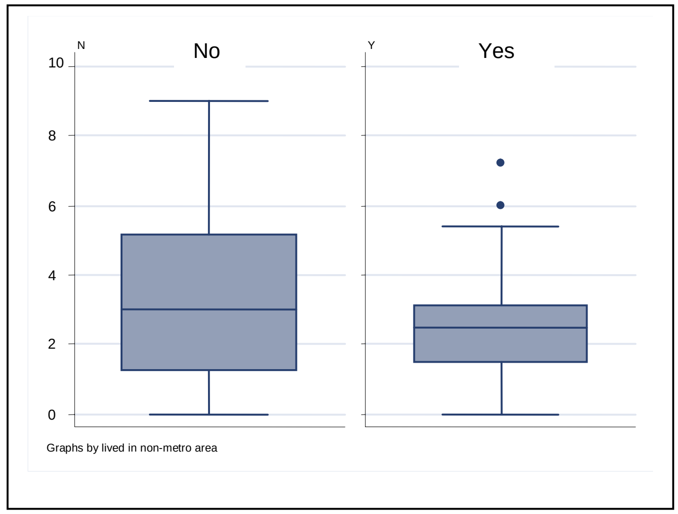


Figure 6.6 Importance of patient location by whether the surgeon lived in a non-metro area for >1 year

Similarly, Figure 6.7 demonstrates that the mean patient location composite score did not differ by whether a surgeon previously practiced in a non-metropolitan area (e.g., mean composite score for surgeons who practiced in a non-metropolitan area = 3.19, 95% confidence interval = 1.98 – 4.41, compared to surgeons who never practiced in a non-metropolitan area mean = 3.11, 95% confidence interval = 2.42 - 3.80) (p = 0.91).

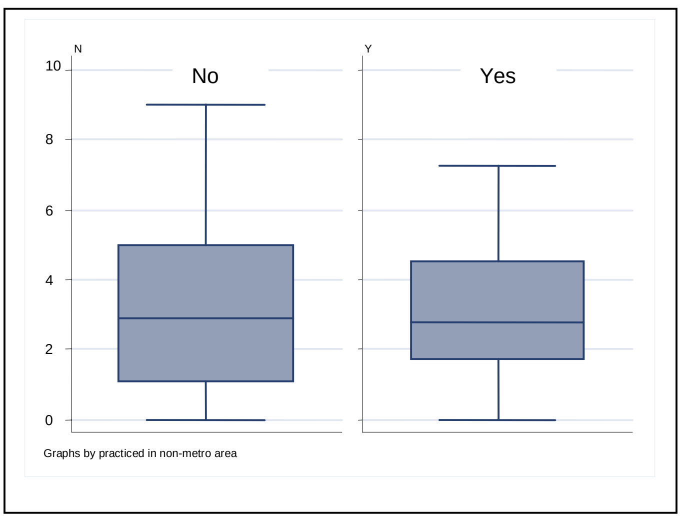


Figure 6.7 Importance of patient location by whether the the surgeon practiced in non-metro area for >1 year

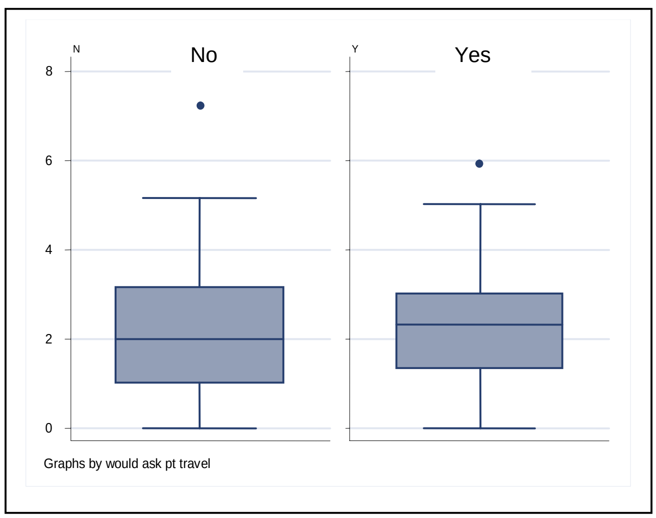


Figure 6.8 Importance of patient location by whether surgeon would ask the patient to travel any distance

Finally, the patient location mean composite score did not differ between surgeons who would ask their patients to travel to the preoperative assessment clinic regardless of where the patient lived versus surgeons who would not ask their patients to travel (i.e. would ask patients to travel mean = 2.61, 95% confidence interval 1.17 - 4.04 versus would not ask patients to travel mean = 2.30, 95% confidence interval 1.54 - 3.06) ($p = 0.68$).

When surgeons were asked if there was a distance beyond which they would not ask a patient to travel to the preoperative assessment clinic, 74% responded ‘no’. However, 17% of surgeons indicated that they would not ask their patients to travel if the patient lived 200 kilometres or further from the clinic. Further, surgeons suggested several strategies that they would employ if their patient lived further than 100 kilometres from the preoperative assessment clinic. Fifty-five percent of the surgeons said that they would ask the patient to travel to the preoperative assessment clinic, 26% would seek a pre-admission consult near the patient’s home, and 17% would employ a variety of options. Alternative strategies included: (1) admit the patient to hospital one day before surgery, particularly if the patient had difficulty traveling or lived further than four hours away, (2) conduct the surgery 1-3 days after the preoperative assessment clinic visit (implicit in this option is that patient can remain in the region between their clinic visit and their surgery), or (3) employ a combination of all of the strategies listed above.

6.5 Discussion

This study demonstrates that surgeons consider patient location factors as less important than either patient medical or health system/practice factors in deciding whether to refer a patient to the preoperative assessment clinic prior to surgery. This pattern was consistent across all surgical specialties. The finding is further supported by the response by a majority of surgeons (74%) who indicated that there was not a distance beyond which they would ask a patient to travel.

Very few studies have examined the importance of distance factors in referral decision-making and even fewer studies have examined referral decision-making by surgeons. Vehvilainen et al (122) studied family physician referrals to a specialist and found that distance to the specialist was not a significant factor in influencing referrals. The present study is also consistent with other studies that have shown that patient clinical characteristics and physician/health system factors are important in deciding whether to refer a patient (109,123-124). Unfortunately, these studies did not include distance-based factors and predominantly focused on family physician referral behavior that may, or may not be applicable to the surgeons in the current study.

The results of this study suggest that the utilization of the preoperative assessment clinic does not depend on patient distance from the clinic, or at the most, slightly depends on distance. This is in contrast to the marked distance-decay effect observed in the first two studies (Study I and II), suggesting that distance factors are indeed important and contribute to the referral decision-making process, along with medical and health system/practice factors. There are several possible explanations for the observed discrepancy between the two studies. A complex mix of patient, surgeon, family physician, and health system characteristics influences surgeon referral decisions. The opinions of only one of the major stakeholders in the referral decision-making process (i.e. the surgeon) were examined. It is possible that the other two primary stakeholders (i.e. the patient and the family physician) played a significant role in the referral decision-making process and subsequent utilization of the preoperative assessment clinic. Previous research suggests however, that patients tend to accept the physician's recommendations with regard to treatment even in cases where the recommendation does not agree with the patient's preferred option (125). Further, in cases where family physicians are involved in referral decision-making, distance to a specialist was not a significant factor in influencing referrals (122). Despite these observations, Vehvilainen et al (122) as well as Chan and Austin (126) both observed that small town or rural physicians refer patients less often than their urban counterparts. Once again, there appears to be a discrepancy between distance as an identified important influencing factor in decision-making and actual referral rates. Additionally, family physicians are not directly involved in the referral process for the preoperative assessment clinic, although they may get involved should their patient request their participation in the decision-making process.

Given the sensitivity and awareness regarding decreased access to health services for patients living in rural or remote areas, it is possible that the surgeons in the present study responded to the questionnaire in a socially favorable way. Numerous studies have identified responder bias as a potential problem in studies that address socially sensitive topics (114). This may be compounded further by the fact that the researchers conducting this study were well known to many of the participating surgeons.

A third possible explanation for the observed discrepancies between the two studies may be the result of the time lag between the preoperative assessment clinic utilization data timeframe (i.e. 1996-1998) and the surgeon survey (i.e. 2005). It could be argued that both the surgeons and surgeon practice patterns changed during that time. The surgeons in the present study practiced in Calgary for an average of 10 years, indicating that the physician population largely remained the same over time. Further, the procedures and processes for referral to the preoperative assessment clinic at the Foothills Medical Centre have not changed over the past decade. Additionally, a study by Franks (127) suggests that physician referral patterns tend to be consistent from year-to-year, indicative of stable practice style traits and behaviors.

A final possible explanation is that surgeons may have employed different strategies to compensate for patient distance, such as admitting the patient to the hospital one day prior to surgery or seeking a preoperative assessment from a local physician or specialist outside of the preoperative assessment clinic. However, the preoperative assessment clinic utilization data used in the current study does not indicate that these patients were admitted the day before surgery. Further, preoperative assessments at the local level would be atypical at this centre with the exception of patients scheduled for a cardiac procedure. A cardiologist often sees these patients before attending the preoperative assessment clinic or instead of attending the preoperative assessment clinic. An examination of the surgical specialty profiles possibly reflects this practice pattern in that cardiac/thoracic surgeons tend to score both health system/practice and patient medical factors lower in importance than the other surgical specialties.

6.5.1 Study Limitations

One of the limitations of this study is the small population of surgeons at the Foothills Hospital. Despite this, a high response rate (84%) was achieved, limiting the effects of non-response bias and therefore risk to the validity of the study. According to the literature, the mean response rates for mailed surveys are much lower for physicians (54%) compared to other groups (68%) (118-119,128). Several strategies were implemented to enhance the response rates in the group of surgeons. For example, the tailored design method proposed by Dillman (114) was applied, as well as use of peer recruitment and monetary incentives to encourage surgeons to participate. Despite the high response rate in the present study, the overall small population of surgeons at the Foothills Hospital placed limitations on the degree to which the preoperative assessment clinic data could be analyzed. The analyses in this study, for the most part, were limited to testing the primary outcomes. The small sample size coupled with a relatively large number of surgical specialties, made subgroup analysis by surgical specialty unfeasible.

The surgeon questionnaire was limited to one double-sided page. Hence, additional questions and factors that may have helped explain the distance-utilization phenomenon were not included. However, according to Dillman (114), it is critical to limit the size of a questionnaire to a length that would be acceptable to the group being surveyed in order to improve the response rate. Further it is critical for the questionnaire to contain clear, concise and relevant questions. This study was able to achieve this by designing the questionnaire based on interviews with several surgeons from different surgical specialties.

Another limitation is that the surgeons who were surveyed came from one academic setting. It is possible that the results are not generalizable to other centres. However, several studies identified similar referral decision-making factors as the present study, but in different clinical scenarios and by different groups of physicians (109, 105, 123-124,127). Several of these studies also identified that patient medical and physician factors were considered the most important factors in the decision-making process (105, 109). Additionally, the results of the current study are important at the local level for the development of policies and perhaps standards of care.

A final limitation of this study is that one component of referral decision-making in the *Behavioral Framework for Health Services Utilization* model was examined. The factors that were assessed were limited to the surgeon's perspective. In order to get a greater understanding of the referral process to the preoperative assessment clinic, the other two major components involved in the decision-making process, patients and family practitioners, should be explored. This is particularly important in the expanding trend toward the shared decision-making model. For example, Whitney (129) describes a model or “decision plane” which recognizes the interaction between patients and physicians in the shared decision-making model and identifies two principal characteristics; namely *importance* and *certainty*. This model helps explain why some decisions involve patients while others do not or involve the patient in a minimal way. The application of this model would be useful for further study of the distance-decay phenomenon and the decision making process for referral to the preoperative assessment clinic.

6.6 Conclusion

The present study demonstrates that surgeons rate the importance of patient location factors as less important than patient medical or health system/practice factors in their decision on whether to refer a patient to the preoperative assessment clinic. This observation does not align with the finding from the first study, suggesting that distance may in fact influence the decision making process. There are clearly other complexities in the decision-making process that remain unknown. Identifying the factors and the decision-making processes involved in referral are important to inform policy directed at the management of the interfaces between the surgeon, the patient, the family physician, and referral to the preoperative assessment clinic to ensure equal access to these centralized services. Further research is required to elucidate the interactions among these three stakeholders including decision-making factors that are important to each group. This is particularly important given the current shared-decision making model.

CHAPTER 7

GLOBAL CONCLUSION

7.0 GLOBAL CONCLUSION

The closing chapter of this thesis begins by highlighting the many benefits that can be gained through the application of multiple methods and interdisciplinarity in health service research. This section is followed by a brief discussion of the results from the three studies conducted in this thesis and the implications for the preoperative assessment clinic. In the final section, the overall concluding remarks are presented.

7.1 Multiple Research Methods and Interdisciplinarity

This thesis goes beyond the conventional use of one method and one discipline to explore a healthcare delivery issue. It provides a good example of how multiple methods and interdisciplinarity can be applied to address a complex health services delivery question such as access to a preoperative assessment clinic.

It is well recognized that research into access to health services is complex and poses numerous challenges for the generation of scientific knowledge. Typically, the study of access to health services falls within the domain of health services research – a broad field of inquiry that focuses on practical issues in the real-world setting. Of note however, is that health services research is not a specific discipline in and of itself. For this reason, numerous academic disciplines are involved in health services research resulting in multidisciplinarity. Unfortunately however, for the most part, studies conducted in health services remain embedded within the single disciplines in which they were undertaken, hence multidisciplinarity is achieved, but interdisciplinarity is not (130). It has been argued that this approach is somewhat limited given that health services problems that occur in the practice setting are not confined to any one scientific subspecialty (i.e. no single discipline can address all aspects of a health service problem) (131). Further, the fragmentation of knowledge that results from this approach is not conducive for effective problem solving and decision-making in the practice setting (132). The generation of knowledge for use in health services can benefit from the integration of disciplines through interdisciplinarity and the application of multiple research methods. Noted benefits include the production of more in-depth, comprehensive, accessible, and applicable knowledge for many stakeholders including health practitioners, administrators, policy-makers and the public (1).

The benefits of implementing a multi-methods, interdisciplinary study to research access to a centralized health service (i.e. preoperative assessment clinic) were clearly demonstrated in this thesis. For example, the first study utilized a standard epidemiological/biostatistical approach to examine preoperative assessment clinic utilization and explore the presence of a distance-decay effect while controlling for potential confounders such as clinical and patient characteristics. While this first study was very informative, it would have left us with only a partial picture. In the second study, GIS was applied to explore the spatial aspects of access (access across geography) to the preoperative assessment clinic, adding a greater depth into the exploration access to this clinic. This method provided clear evidence of the distance decay phenomenon that can be quickly and easily viewed by a wide array of stakeholders including healthcare practitioners, policy-makers, and the public. It also provided insight into how easy it is to ‘lie with maps’ by presenting data in an inappropriate manner. The application of GIS also was valuable for understanding some of the geographical aspects of the data such as identifying relatively large pockets of patients where access to the preoperative assessment clinic may be more difficult due physical barriers such as mountains and lakes, and which patients (by location) contribute to the distance categories constructed in the first study. The third study explored the distance phenomenon further by examining whether surgeons consider patient location as an important factor when deciding whether to refer their patient to the preoperative assessment clinic for a medical evaluation prior to surgery. The results of the present study indicate that while medical and health system factors were deemed to be the most important components in a surgeon’s decision whether to refer their patient to the preoperative assessment clinic prior to surgery, patient location was also considered. As well, surgeons indicated that they would implement a variety of strategies to manage patient distance issues.

The benefits of undertaking health services research within an interdisciplinary – multiple methods paradigm are powerful because they address some of the information gaps that currently exist within health services research. While there are numerous pockets throughout academic institutions where these approaches are taking place to study complex phenomena, the need for an enhanced research training program that fosters interdisciplinarity is perhaps worthy of further exploration and discussion. Not only would this type of program assist in the building of new knowledge but also would encourage the cross fertilization of knowledge, skills, methods and concepts across many disciplines.

This thesis provides one example or model for achieving interdisciplinarity in health services research. In this instance, the researcher (i.e. PhD student) was able to gain expertise in two disciplines, epidemiology/biostatistics and geography, by creating a graduate committee that brought the expertise from these areas together. This model can be viewed as achieving interdisciplinarity within one individual, but also highlights the potential value of bridging educational activities from different disciplines, thus creating a forum where one discipline can learn about the other through shared learning and collaboration. Of note, clinician-biostatistician interdisciplinarity has been a long-established relationship and form of interdisciplinarity. This thesis however, involved the bridging of geography, epidemiology/biostatistics, and clinical perspectives which are valuable and perhaps less typical.

A second model for interdisciplinarity research exists within the Faculty of Graduate Studies at the University of Calgary. In this formal model, graduate interdisciplinary training is achieved through a formalized process that involves two disciplines and training that is centered on the individual graduate student's needs.

The Canadian Institutes for Health Research (CIHR) provides another example of developments in the area interdisciplinary research. The CIHR recognizes the importance of interdisciplinarity for the creation of new knowledge to tackle important health problems. One of their stated key objectives is *"to forge an integrated health research agenda across disciplines, sectors and regions that reflects the emerging health needs of Canadians and the evolution of the health system*" (133). As such, the CIHR has created funding opportunities to facilitate growth in interdisciplinary research. For example, the Interdisciplinary Capacity Enhancement Teams Grant program is directed at building capacity in interdisciplinarity through research, educational, and mentorship activities, by supporting teams of new and existing investigators who are active in these endeavors (133). These programs are in their early stages, but clearly the ease with which this model is implemented will be highly dependant on each researcher's understanding of the value of interdisciplinary research and commitment to the process.

7.2 Implications for the Preoperative Assessment Clinic

The preoperative assessment clinic was utilized as a case study in this thesis to explore the application of multimethods and interdisciplinarity to address a complex area of study (i.e. access to a centralized health service). The majority of research regarding the centralization health services tends to focus on highly specialized treatments delivered by tertiary and quaternary centres, such as cardiovascular procedures, neurosurgery, and cancer care. In these cases, somewhat limited access may be deemed an acceptable tradeoff for high quality care achieved through high volume service (50). The study of the preoperative assessment clinic is somewhat different given that this service is considered less complex, albeit extremely important, and the tradeoffs between access and the highest quality treatment benefits may not be as apparent.

Preoperative assessment clinics are important clinical services that have potential benefits for both patients and the health care system. The ultimate goal of this health service is to provide an efficient assessment of surgical patients prior to surgery. The benefits include a decrease in average costs associated with unnecessary laboratory tests, cancelled or delayed surgery, additional cost associated with intraoperative complications, and extended post-operative patient length of hospital stay. Improved clinical documentation and patient education also are recognized benefits. Preoperative assessment clinics are typically located within tertiary care centres.

The results from the three studies conducted in this thesis have implications for access to the preoperative assessment clinic. Similar to other a centralized health services, patient access to the preoperative assessment clinic appears to be compromised for those living outside of the boundaries of the Calgary Health Region. This study identified that the utilization rate for patients living within 50 kilometres from the Foothills Medical Centre (approximately the boundaries of the Calgary Health Region in 1996-1998) was 66%, yet 26% (N=2512) of the patients in the present study experienced utilization rates that were considerably lower, ranging from a high of 52% for the closest geographic patient group, down to 30% for the most distant groups. For example, it would appear that access to the preoperative assessment clinic is particularly problematic for patients living in the Kootenay Health Region in British Columbia (e.g., 32% of patients were seen in the clinic). Of note, the current study did not assess whether the overall utilization rate of the preoperative assessment clinic was appropriate or optimal (i.e. assessment of over or under utilization), but rather whether there was notable variation in utilization across geographies, reflective of access differentials based on geographic location of patients. It could be argued that the higher utilization rate in Calgary may represent over utilization, while the preoperative assessment clinic utilization rate for patients living outside of Calgary may be more appropriate. Of note, higher rates of referral to preoperative assessment clinics are reported in the literature (e.g., Harvard Medical Centre (43)). However, reported rates may be more reflective of differing processes and procedures then the appropriateness of referrals.

In addition to the observed variability in utilization rates based on patient location, it was noted that surgeons do in fact consider patient location in their decision on whether to refer their patient to the preoperative assessment clinic prior to surgery, albeit location factors were rated as far less important than medical or health system factors, but are considered none the less. The present study is limited because it is not clear what role the patient plays in this decision-making process. This study did not address the perceptions, needs, beliefs, and challenges faced by one of the key stakeholders in the referral decision-making process and users of this service, namely the patient. This is a critical piece of information that is currently missing and one that warrants study.

In Chapter 4, several options were proposed to address access disparity for patients living outside of the Calgary Health Region. These included asking patients to travel regardless of where they live, implementation of satellite clinics, or the application of telemedicine technology, among several suggestions. Further, the surgeons in the current study identified several strategies that they employ to assist patients from remote areas. In any case, all of these options have policy and cost implications for both patients and the health system regarding the delivery of this important health service. A recent survey of elective surgery patients in Alberta demonstrates that patients believe that the services provided at a preoperative assessment clinic are important for their care (44). There is a need however, to explore access issues from the perspective of the patient and those individuals involved in their care (e.g., relatives, friends, local volunteer groups, care providers).

As the restructuring of health care in Canada continues, it is likely that regionalization and centralization (spatial redistribution or reordering of services) of many more health services that extend beyond highly specialized and technically complex treatments and services will continue. This has implications for those individuals who are geographically distant from those services. Not only are these populations faced with the challenges of geography, they also experience low population density and overall decreasing availability of many services including health services, at the local levels (134). Importantly, Hanlon and Skedgel (50) point out that in rural and remote regions, geographical barriers to health services are dependant on the local context and how services are delivered, and therefore the restructuring of health care impacts non-urban regions differently than their urban counterparts. Hence, the geographic aspects of access should be taken into consideration when planning health services that cross the urban-rural continuum.

7.3 Conclusions

The studies presented in this thesis provide a good example and template for the application of a multiple method and interdisciplinary approach to study a complex research area such as health services research. Interdisciplinarity is a powerful paradigm that facilitates the generation of comprehensive knowledge required to address many of the issues faced in health services today. The preoperative assessment clinic was used as a case study. The results from the present studies demonstrated that access to this centralized service may be compromised for individuals living outside of the Calgary Health Region. Further study on access to the preoperative assessment clinic is required to understand patients' perspectives and challenges in utilizing this health service.

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APPENDIX A: STUDY 1 ACKNOWLEDGEMENT

Acknowledge of co-authors for the following study: *Location of residence associated with the likelihood of patient visit to the preoperative assessment clinic (51)*

I would like to thank all of the co-authors of this publication for their valuable input into the editing of this paper and approval of the final draft for publication in BMC Health Services Research.

APPENDIX B: BEHAVIORAL FRAMEWORK DOMAINS AND LIST OF ASSOCIATED FACTORS

A. Health system/service related factors
- quality of care
- individual patient management
- previous patient outcomes
- timely access to preoperative assessment clinic
- cost to the health system

B. Physician related factors
- personal benefits
- past experience with the preoperative assessment clinic
- beliefs about the preoperative assessment clinic
- attitudes of colleagues and the local medical community about the preoperative assessment clinic
- department's expectations regarding referral
- improves ability to care for patient
- perform diagnostic tests
- meet a standard of care
- assistance with patient education
- risk of liability

C. Patient related factors
- socioeconomic and demographic factors
- burden of comorbidities
  - diseases affecting the cardiovascular system
  - diseases affecting the pulmonary system
  - diseases affecting the hepatic system
  - diseases affecting the endocrine system
- nature of the surgical procedure (major, minor, diagnostic)
- potential for productive remaining life
- physical mobility
- obesity
- smoking
- types of medications
- allergies or previous problems with anesthetic agents
- previous use of health care system
- previous use and satisfaction with preoperative assessment clinic
- preference or expectations for referral
- cost to the patient (e.g. travel, lodging, lost wages)
- convenience to the patient (e.g. discomfort traveling, family support availability)
- distance from the preoperative assessment clinic

- requirement for assistance from others to travel
- patient home location (rural vs. urban setting, and BC vs. AB)
- functional status of the patient (physical and mental)
- anxiety about surgery
- time of year the patient travels (season and weather)
- modes of transportation (ownership or access to car, other forms of transportation)

APPENDIX C: SURGEON QUESTIONNAIRE

Utilization of Regional Pre-Admission Clinics (PAC)

Study ID ______

After each factor listed below, please circle the number (0 to 10) that best describes how **important** you feel that factor is when deciding whether to refer or to not refer your patient to the pre-admission clinic prior to surgery.

Patient Medical Factors	Not at all Important										Extremely Important
Age of the patient	0	1	2	3	4	5	6	7	8	9	10
Burden of comorbidities:											
- cardiovascular disease	0	1	2	3	4	5	6	7	8	9	10
- pulmonary disease	0	1	2	3	4	5	6	7	8	9	10
- hepatic disease	0	1	2	3	4	5	6	7	8	9	10
- endocrine disease	0	1	2	3	4	5	6	7	8	9	10
- renal disease	0	1	2	3	4	5	6	7	8	9	10
- cerebrovascular disease	0	1	2	3	4	5	6	7	8	9	10
- neurological disease	0	1	2	3	4	5	6	7	8	9	10
Nature of the surgical procedure (i.e. major vs minor procedure)	0	1	2	3	4	5	6	7	8	9	10
Physical mobility of the patient	0	1	2	3	4	5	6	7	8	9	10
Patient obesity	0	1	2	3	4	5	6	7	8	9	10
Smoking history	0	1	2	3	4	5	6	7	8	9	10
History of alcohol abuse	0	1	2	3	4	5	6	7	8	9	10
Use of specific medications:											
- anticoagulants (e.g. warfarin)	0	1	2	3	4	5	6	7	8	9	10
- anti-platelets (e.g. ASA, clopidegrel)	0	1	2	3	4	5	6	7	8	9	10
- corticosteroids	0	1	2	3	4	5	6	7	8	9	10
- other medications, specify ________________	0	1	2	3	4	5	6	7	8	9	10
Number of current medications	0	1	2	3	4	5	6	7	8	9	10
Previous problems with or reactions to anesthetic agents	0	1	2	3	4	5	6	7	8	9	10
Allergies to medications and/or environmental agents	0	1	2	3	4	5	6	7	8	9	10
The functional status of your patient: Mental status	0	1	2	3	4	5	6	7	8	9	10
Physical status	0	1	2	3	4	5	6	7	8	9	10

Patient Location and Non-medical Factors

The number of kilometers your patient lives from the PAC	0	1	2	3	4	5	6	7	8	9	10
The amount of time it takes your patient to travel to the PAC	0	1	2	3	4	5	6	7	8	9	10
Your patient has physical difficulty (discomfort) traveling long distances	0	1	2	3	4	5	6	7	8	9	10
Your patient requires extra assistance from family or friends to get to the PAC	0	1	2	3	4	5	6	7	8	9	10
The mode of transportation your patient must take to get to the PAC (e.g. car, bus, or plane)	0	1	2	3	4	5	6	7	8	9	10
Time of year (season) that your patient has to travel	0	1	2	3	4	5	6	7	8	9	10
The weather conditions when your patient has to travel	0	1	2	3	4	5	6	7	8	9	10
Your patient lives outside of Alberta (e.g. BC or Sask.)	0	1	2	3	4	5	6	7	8	9	10
Your patient lives in a rural community (< 50,000 population)	0	1	2	3	4	5	6	7	8	9	10
Additional costs to your patient/family to travel to the PAC:											
- travel costs	0	1	2	3	4	5	6	7	8	9	10
- lodging costs if they have to stay in Calgary	0	1	2	3	4	5	6	7	8	9	10
- lost wages or time off work	0	1	2	3	4	5	6	7	8	9	10
Whether your patient has family or friends as a social support	0	1	2	3	4	5	6	7	8	9	10

Please turn over ……

	Not at all Important										Extremely Important
Your patient's previous experience with the PAC	0	1	2	3	4	5	6	7	8	9	10
Your patient expressed anxiety about his/her surgery	0	1	2	3	4	5	6	7	8	9	10

Health System and Practice Related Factors

Your satisfaction with previous referrals to the PAC	0	1	2	3	4	5	6	7	8	9	10
Your beliefs about the benefits of the PAC	0	1	2	3	4	5	6	7	8	9	10
The attitudes of your colleagues about the PAC	0	1	2	3	4	5	6	7	8	9	10
Quality of care your patient receives at the PAC	0	1	2	3	4	5	6	7	8	9	10
To reduce the risk of cancellation of the surgery on the day of the procedure	0	1	2	3	4	5	6	7	8	9	10
The waiting time for PAC appointment	0	1	2	3	4	5	6	7	8	9	10
To provide your patient with an introduction to the hospital's surgical care services prior to their surgery	0	1	2	3	4	5	6	7	8	9	10
To improve your ability to care for the patient	0	1	2	3	4	5	6	7	8	9	10
To perform a diagnostic test (e.g. ECG, CXR, ABG)	0	1	2	3	4	5	6	7	8	9	10
To assist in ruling out potentially dangerous conditions	0	1	2	3	4	5	6	7	8	9	10
To meet a standard of care	0	1	2	3	4	5	6	7	8	9	10
To receive consultation from: - anesthesiology	0	1	2	3	4	5	6	7	8	9	10
- internal medicine	0	1	2	3	4	5	6	7	8	9	10
- nursing (patient education)	0	1	2	3	4	5	6	7	8	9	10

1. Are there any other factors not listed above that influence your decision to refer or to not refer to the PAC?

   ____

   ____

2. Is there any single factor that drives your decision to refer or to not refer a patient to the PAC?

   ____

3. How many years have you been practicing in Calgary? _________ (years)
4. Approximately how many surgeries did you perform in the past 12 months? ___________ (# of surgeries)
5. Approximately what percentage of patients did you refer to the PAC in the last 12 months? _________%
6. What percentage of your surgeries are delayed as a result of referring your patients to PAC? _________%?
7. Have you ever lived for 1 year or more in a non-metropolitan centre (i.e. population < 50,000)? __Yes __No

   If Yes, where? ______________________________________

8. Have you ever practiced medicine in a non-metropolitan centre (i.e. population < 50,000)? __Yes __No

   If Yes, where? ______________________________________

9. If your patient lives greater than 100km from Calgary, which strategy are you most likely to employ?
   a. Refer the patient to the PAC in Calgary (i.e. where the patient lives does not matter)
   b. Seek a pre-admission consult near the patient's home
   c. Admit the patient to the hospital one day before surgery
   d. Other (please specify) ______________________________________

   If you selected "**a.**" above, is there a distance beyond which you would not ask your patient to travel to the PAC? ___ Yes ___ No If you selected "**Yes**", please specify the distance _________ (km)

10. Where did you receive your surgical residency training? ________________________(University/Hospital)
11. In what year did you complete your surgical residency training? ___________

Thank you for your time. Your contribution to this study is very much appreciated.