

**EXAMINING THE SPATIAL ACCESSIBILITY OF
PALLIATIVE CARE SERVICES IN BRITISH COLUMBIA:
RECOMMENDATIONS FOR PROVIDING CARE IN BC'S
RURAL AND REMOTE REGIONS**

by

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Bachelor of Arts (honours), Ryerson University, 2007

THESIS SUBMITTED IN PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF ARTS

In the
Department of Geography

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SIMON FRASER UNIVERSITY

Summer 2009

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ABSTRACT

An increased need for palliative care services (PCS) has been acknowledged worldwide as the populations of many countries age. Despite this, implementation of PCS has been piecemeal in many jurisdictions. Canadian end-of-life care frameworks are beginning to address this shortcoming; however, they have largely failed to consider the challenges of delivery in rural and remote regions. This thesis examines the spatial accessibility of PCS in British Columbia (BC), and introduces the concept of palliative care hubs (PCH) for delivery in BC's under-populated regions. Spatial analysis techniques are used to identify communities that are outside of primary PCH service catchments, the proportion of the population of each Health Authority considered to be without spatial access, and the suitability of regional communities as sites for new secondary PCHs. Implementation of hubs in the most suitable communities could provide residents of surrounding regions with enhanced access to appropriate, multidisciplinary PCS at the end-of-life.

Keywords: GIS, spatial analysis, palliative care, health services, rural, remote, British Columbia, Canada.

ACKNOWLEDGEMENTS

I am indebted to my academic supervisors, Nadine Schuurman and Valorie Crooks for introducing me to the research topic, providing insight on multiple revisions of this thesis, and for continual support throughout the research period. I am grateful to my external examiner, Denise Cloutier-Fisher for her excellent comments and suggestions. I also thank my family and friends, and the graduate students, staff and faculty of the department of geography at SFU for assistance and support.

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CHAPTER 1

INTRODUCTION

1.1 Overview

Palliative care is the term used to describe the broad range of services available for people with a life-limiting illness and their carers. Palliative care diverges from traditional health care because the intention is therapeutic not curative, thus the mission of palliative care is on reducing the severity of symptoms and improving the quality of the patient's remaining days, not on changing the outcome of the illness (Kristjanson & Hobbs, 2001). Palliative care is holistic care in that it seeks to address the spiritual, physical, emotional, and social consequences of chronic or terminal illness. The World Health Organization has outlined a broad scope for palliative care. Palliative care is intended to; relieve pain and distressing symptoms, regard dying as a normal process, integrate the psychological and spiritual aspects of patient care, provide a support system to help patients live as actively as possible, and to help the family cope during the patient's illness and bereavement period (World Health Organization, 2007). What is included within the palliative care service basket includes but is not limited to; pain management, spiritual services, and comfort care. In addition to services and care for the patient, a host of services are available for the dying person's family, caregivers, and loved-ones, including counselling for grief, bereavement support, and memorial service planning (Carlson *et al.*, 2007; Carstairs, 2005; Currow *et al.*, 2008; Saunders, 2000).

In Canada, health and some social care services should be equally available to all citizens in an equitable manner (Government of Canada, 1984). Despite this, research from Canada and many countries around the world repeatedly suggests that health services are far from uniformly accessible (e.g. French *et al.*, 2006; Magilvy & Congdon, 2000; Moorin & Holman, 2006). Many factors act as barriers to accessing health services including socio-economic status and geographic location. The result of these barriers means that people with restricted incomes, and those living in rural and remote regions are less likely to have contact with the health care system, and can be more likely to have poorer health outcomes.

The reality that health care services are not equally accessible by all has started to drive policy making in palliative care (Ahmed *et al.*, 2004). In Canada, recent policy instruments concerning end-of-life care have recognized the need for improved access to and availability of a wide variety of quality, appropriate palliative care services (e.g. British Columbia Hospice Palliative Care Association, 2005; Canadian Institute for Health Information, 2007). As a result of the ever-present restrictions on health care spending in Canada, strong evidence is required to support palliative care service allocation decisions. Research can produce such evidence. Research on health service accessibility is increasingly informed by geographic knowledge, in particular by the use of modelling and spatial analysis techniques available in Geographic Information Systems (GIS). This is particularly true in recent years with the refinement and introduction of novel spatial accessibility and location analysis methods.

This research seeks to address the recent recognition in Canada that access to palliative care services is not enjoyed by all. GIS and location analysis methods are

harnessed to examine the spatial accessibility of palliative care services in British Columbia. Access to palliative care services is calculated based on travel-time to the nearest provider and compared between each of British Columbia's Health Authorities. Communities that are considered to be outside of practical service area catchments are identified. A location analysis model was developed and used to rank these un-served communities for suitability as new sites of palliative care delivery – designated as the secondary palliative care hub. A major contribution of this research is the evidence it provides regarding the inadequate state of palliative care accessibility in rural and remote regions of British Columbia. The findings of the community suitability model can be used to support evidence-based planning to improve palliative care service availability in these regions of British Columbia. Furthermore, demonstration of the spatial accessibility methods and location analysis model may be useful in supporting other health or social service resource allocation decisions.

1.2 Research Problem

Health policy makers and researchers concur that demand for palliative care services will grow in the coming years, in large part due to the fact that populations are aging rapidly and the numbers of people living with chronic illnesses is increasing (Connor, 2007; Kuebler *et al.*, 2005). On top of this, ever-stretched health care budgets require that resource allocation decisions be made with the best available knowledge (Eyles *et al.*, 1991; Litaker & Love, 2005; Sweatman & Woollard, 2002). As palliative care emerges into the mainstream of health care, it is becoming apparent that past implementation of services has largely been conducted in an ad-hoc, piecemeal fashion. The consequence of this reality is that the availability of services varies greatly by

geographic location, perhaps more than other health services with a longer history of mainstream integration.

Health organizations have acknowledged an increased demand for palliative care services and have expressed a desire to expand the availability of wide-ranging and appropriate services for patients in the end stages of life. In 2006, the British Columbia Ministry of Health (Government of British Columbia, 2006) released a framework on end-of-care in which the imminent need for improved availability of services for all residents of the province is described (p. 5):

“Appropriate services should be available where people live or, if this is not feasible, as close as possible to where they live, in the setting that is preferred by the person and their family and in a timely manner. Regardless of their particular disease, end-of-life services should be available to all people who want them, including children and younger adults”.

What is largely missing from this and other recent Canadian policy documents on palliative care is recognition of the unique circumstances of actually delivering quality, multidisciplinary palliative care in rural and remote regions, and explicit instruction on how to do so. This research seeks to address this knowledge gap.

1.3 Research Objectives

The overall objective of this thesis is to highlight inadequacies in palliative care service provision in British Columbia, and contribute evidence that can be used to allocate resources to increase the spatial access and use of these services for residents of traditionally under-served regions of the province. The following research questions guide this thesis in search of the overall goal:

1. What is the current spatial distribution of palliative care services in British Columbia?
2. What areas of the province are under-served for palliative care?
3. What regional centres in BC that currently do not possess palliative care services are appropriate candidate locations for implementation as secondary palliative care hubs to service the rural and remote regions of BC?

In addition to the main objective, a secondary goal of this thesis is to outline a set of spatial analysis methods that can be applied to other health resource allocation problems.

1.4 Background, Context, and Literature Review

The following section provides summarized background information on topics and methods central to this thesis. To begin, recent arguments for greater integration of palliative care into the mainstream health care system are introduced. This is followed by an explanation of issues surrounding access to health care services with a special focus on spatial accessibility. The next topic covered is health service allocation, and the palliative care hub (PCH) concept for delivering care in rural and remote regions is introduced. Lastly, the place of geography within health care research is discussed, including the use of GIS methods such as spatial accessibility and location analysis modelling.

1.4.1 Palliative Care: the Rationale for Appropriate End-of-Life Care

The Mainstreaming of Palliative Care

Consideration of having access to palliative care as a human right is gaining acceptance worldwide (Brennan, 2007; Wright *et al.*, 2008). In Canada, many factors have propelled interest in end-of-life care issues in recent years. A major contributor to this growth comes from a desire to improve the quality of life for those affected by life limiting illness, death, and bereavement through provision of high quality, multidisciplinary, and appropriate care (British Columbia Hospice Palliative Care Association, 2005; Krakauer, 2008). Also, evidence suggests that once a patient's prognosis becomes terminal, initiating palliative care is a cost-effective option (Fassbender *et al.*, 2005). Another key impetus driving palliative care development in Canada is the fact that the population is aging (Robinson *et al.*, 2009); this rise in the number of older people is adding new pressures on the health care system. Additionally, the documented rise in the burden of chronic disease is producing more potential palliative care recipients. The result of these factors is escalating demand for appropriate and accessible palliative care. To address these concerns, health care organization and policy-makers are now calling for better integration of palliative care within the mainstream health care system (Canadian Institute for Health Information, 2008; Government of British Columbia, 2006).

This newfound interest in improving the integration of palliative care within mainstream health care mirrors the expansion of palliative care to include patients for a longer period before a terminal prognosis (Kuebler *et al.*, 2005). These services are

increasingly promoted for all patients with a range of life-limiting illnesses, not just those with cancer, as was the traditional focus (Jakobsson *et al.*, 2007; Paroz & Santos-Eggimann, 2009). These services can benefit all age groups; however, recent evidence suggests that palliative care is under-utilized by patients in some age groups including adolescents (Schrijvers & Meijnders, 2007), and children (Browning & Solomon, 2005).

Settings for Palliative Care

Palliative care is provided in a variety of settings and locations. In Canada, the types of palliative care services offered are unique to each community or region and reflect the competence and evolution of the health care system in each locality (Dudgeon *et al.*, 2007). Hospitals may have dedicated palliative care wards, or the ability to provide palliative services when needed, depending on both the size of the hospital and the demands of the local population. Hospice residences are facilities that are usually solely dedicated to end-of-life care, with residency spaces for the terminally ill and programming devoted to improving the quality of life of patients while they are still alive (Connor, 2007). Hospice residences in British Columbia each have their own mandate and varying levels of service, many of which are operated independent of the local Health Authority and receive financial support through a charitable structure. Palliative care can also be provided in-home, as informal care-givers and palliative specialists are often able to accommodate and treat patients at their place of residence. Furthermore, it must be noted that palliative care can happen exclusively within the informal and voluntary sectors - much care for the terminally ill and dying is unpaid and performed by

volunteers, community activists, and members of the care-recipient's family (Williams, 2006).

1.4.2 Health Care Service Accessibility

Health care access research is broad and multi-focused. Access studies examine many aspects of health care provision, including; wait-list times to undergo a medical procedure, health care information availability, quality of care available, in addition to the availability of services in terms of a patient's socio-economic status or geographic location. These studies provide important evidence of the inequitable service accessibility for many different groups in society, including the socio-economically disadvantaged (Williamson *et al.*, 2006), those with impairments (Gulley & Altman, 2008) and new immigrants (Asanin & Wilson, 2008; Wang *et al.*, 2008).

Residents of rural and remote areas are burdened by multiple barriers that may limit access to health services. Geographical distance is an obvious barrier; if services are unavailable in the local area, patients must travel to the nearest centre to receive treatment. Also intertwined with the friction of distance are the financial barriers that residents of rural and remote areas are more likely to experience. Travel to and from urban centres to access health care requires financial resources to pay for transportation and accommodation. There are many other issues in addition to the more obvious barriers of distance and financial costs of travelling. For example, a study examining rural mental health services for children highlighted the fact that adverse weather conditions, limited public transportation, lack of information, and lack of anonymity are also factors that determine whether and where services are sought (Boydell *et al.*, 2006). Also, other, more indirect barriers to rural health care access are beginning to emerge. For example,

Caldwell and Arthur (2009) identified a ‘culture of referral’ that resulted in fewer transfers of rural patients to urban cardiovascular specialists. The combination of all of these factors place residents of rural and remote regions at a particular disadvantage.

Barriers to accessibility influence whether or not a patient will receive care. For example, a study by Nemet and Bailey (2000) confirmed an association between increased distance from health service providers and reduced utilization of services among the elderly population. In British Columbia, a study that analyzed radiation therapy utilization and proximity to cancer centres found that people residing at greater distances from the centres were less likely to be referred for an initial consultation (French *et al.*, 2006). Field and Briggs (2001) highlighted the relationship between increased travel-time from a general practitioner with decreased overall utilization of their services. What is apparent from these and other health care accessibility studies is the possibility that barriers to health service utilization could be responsible for poorer health outcomes in those residents subject to reduced accessibility.

Access to Palliative Care Services

Equal access to services for all is a central focus guiding palliative care policy. The vision of the Canadian Hospice Palliative Care Association is “that all Canadians have access to quality end-of-life care” (Canadian Hospice Palliative Care Association, 2009). Studies abound that describe the irregular accessibility of palliative care. For example a literature review by Walshe *et al.* (2008) highlighted the reality that potential palliative recipients who are; older, male, from ethnic minority populations, are unmarried, do not have a in-home caregiver, are socioeconomically disadvantaged, and are

managing an illness other than cancer are all less likely to access community-based palliative care services.

A small number of recent studies have examined the spatial aspects of palliative care accessibility. Results have illustrated a striking variation in the availability of palliative services by geographic location, often with rural and remote areas highlighted as particularly lacking (e.g. Beccaro *et al.*, 2007; Virnig *et al.*, 2006; Wood *et al.*, 2004). Wright *et al.* (2008) created a global map of palliative care development. The map illustrates a strong correlation between human development and the extent of palliative care development and integration within the mainstream health care system. These studies are informative; however, they are often coarse-scale analyses or have a solely descriptive intention. What is most deficient in these, and many spatial analyses of health care are explicit directions for reducing geographic inequities in service provision in the study area.

1.4.3 Health Care Service Allocation

New strategies for organizing and delivering health care are needed to respond to the mounting challenges of accessibility. Importantly, these strategies must be cost-effective in a constant climate of health budget cuts and system streamlining in Canada.

There is great interest in exploring new models of care to ensure the provision of appropriate, compassionate, and coordinated care to all who may benefit at the end-of-life (Canadian Institute for Health Information, 2007). Rapid, ad-hoc, and unplanned development of palliative care is at least partially responsible for poor spatial accessibility in some jurisdictions (Beccaro *et al.*, 2007). These geographic inequities in

palliative care accessibility will become more apparent in the coming years; thus, there is great need to focus on improving rural palliative care delivery (Robinson *et al.*, 2009).

The Palliative Care Hub Service Organization Concept

Realistically, multidisciplinary palliative care cannot be implemented in every community owing to resource constraints, both personnel and financial. This thesis introduces a pragmatic concept for delivering care - designated the palliative care hub (PCH) - as a means of addressing geographic disparities in access to palliative care services. The intention of the PCH is to improve access to quality, appropriate, and multidisciplinary care for residents of rural and remote regions. The PCH concept includes primary and secondary hubs. Primary PCHs are existing sites of specialized palliative care delivery located in larger centres, including hospice residences and hospitals with a dedicated specialized palliative care unit. It is envisioned that newly designated secondary PCHs will be located in the most appropriate regional communities so as to provide care to the largest number of potential users in the local region. Secondary PCHs may or may not operate out of physical locations designated as sites specific to palliative care; this could depend on the current facilities available in the targeted community, and funding available for such a project. Secondary PCHs could potentially operate out of a hospital or extended care facility. In some potential secondary PCH communities, a physical location may not be required at all as care can be delivered out of the patient's home. One of the foremost ingenuities offered by the hub concept is the necessity to create strong links between secondary PCHs and existing primary PCHs. Primary and secondary hubs could be networked using information technology so local

practitioners and patients in smaller secondary hub communities would be synchronized with multidisciplinary palliative specialists stationed in larger primary hub communities. Greater detail regarding the concept, functions, and purpose of the PCH service organization model are described in Chapter 3.

Newly designated PCHs should be strategically located so as to provide these services to the greatest number of potential palliative care users that are currently unserved in rural and remote regions. The following section describes the appropriateness of a health geography approach to this problem, and suitable spatial analysis methods that can be harnessed for this purpose.

1.4.4 Geography, GIS, and Health

There is increasing recognition that the majority of public health issues have a spatial component, perhaps 90% or more (Public Health Agency of Canada, 2007). A result of this awareness is the increasing utilization of the methods and theories available in the geographer's toolbox to support research in public health and health services.

Health geography is a sub-field of the human geography discipline that borrows from the two traditional streams of geography, human and physical. This sub-discipline draws on knowledge from human geography, in particular the importance of place, culture, human interactions, and our built and social environments on the health of populations, and from positivist physical geography, particularly the application of statistical and analytical methods (Asthana *et al.*, 2002; Cutchin, 2007; Kearns & Moon, 2002). The use of methods and theories from both sides of geography, and from recent trends in interdisciplinary collaboration, has contributed to greater understanding of the

relationship between human health and our built, social, and natural environments. In Canada, this sub-discipline has experienced rapid development. Unique contributions to health geography have arisen because of the distinctive multicultural diversity evident in Canada's urban centres, and the variety of spatial scales of influence in Canada, including large cities and vast rural and remote regions (Luginaah, 2009).

GIS can be applied to inform public health policy and planning. GIS methods are used to examine the spatial distribution of disease, injury, and determinants of health, to monitor disease outbreaks, and for targeting prevention and health promotion initiatives (Dummer, 2008). Also, GIS techniques are particularly useful for describing and understanding the spatial organization of health care services, and subsequently, for exploring how care delivery could be improved (McLafferty, 2003).

Health resource allocation decisions must be based on strong evidence of appropriateness. GIS-based spatial modelling techniques can contribute to evidence-based decision making for health care service allocation. Studies using GIS and spatial analysis have been conducted to look at the geographical accessibility of health services in countries and regions with scattered populations so as to determine the proportion of the population that services are reaching, and thereby analyzing the effectiveness of current health resource allocation methods (e.g. Asthana *et al.*, 2004; Harper *et al.*, 2005). Spatial accessibility methods can be used to highlight populations and regions with unfavourable access to health services. Location analysis models provide evidence of the suitability of locations for a given purpose by assessing the factors and constraints that suggest their appropriateness.

Spatial Accessibility Modelling

Several spatial accessibility modelling techniques are available. It is possible that the choice of technique may highly influence the results, thus, an appropriate technique must be applied. Determining the method most suited to a problem requires several considerations. An important consideration is to choose a method that is suited to the study area. Some techniques are more appropriate for fine-grained analyses, such as those examining access within a city boundary, while others are best applied over large regions, for example studies that assess spatial accessibility at the level of region, province, or nation.

Guagliardo (2004) described several categories of spatial accessibility models: provider-to-population ratios, distance to nearest provider, and gravitational models of provider influence. Each type has positive and negative aspects that the modeller should be aware of before making recommendations. Provider-to-population ratios are useful if the aim is to compare a relative value indicating service supply and population demand between different areas. The function of provider-to-population ratios is limited, particularly in urban settings, because within-area variations cannot not measured, and border-crossing is not taken into account, an actuality for many patients accessing health services. Distance to nearest provider models are particularly suited for examining rural accessibility because it is probable that a patient will seek care with the nearest provider. For this reason, these models are not well-suited to urban areas where many service providers are located and the patient has multiple transportation options. Distance to provider can be calculated using Euclidean (straight-line) distance, road network distance, or travel-time along a road network. Euclidean distance between a patient's

home and a health care facility is seldom an appropriate measure of accessibility, particularly in rural areas characterised by diverse terrain and topography (Lin *et al.*, 2002). Road network distance is likely much more accurate than straight-line distance; however, the distance between two entities is only part of the accessibility equation. Travel-time to provider (or indeed, travel-time for the provider to the patient's home) is ostensibly the most accurate way to calculate the distance to the nearest provider because road type, travelling speed, and impacts on travel can be integrated into the model.

Location Analysis Modelling

The location of facilities and services is a common concern in the public and private service sectors realms. In the private sector, facilities must be appropriately located to ensure costs are minimized and that they are accessible by customers. Inappropriately located facilities can result in poor economic performance for business and industry. Facility location and service allocation may be even more important in the public sector. The result of improper health facility or service allocation decisions could mean increases in mortality and morbidity and reduced availability of services, in addition to inflated operating costs (Daskin & Dean, 2004).

Location analysis includes the modelling, formulation, and solution of a facility siting or resource allocation problem in a given space (ReVelle & Eiselt, 2005). Given that facility siting and resource allocation decisions require verification of their appropriateness, location analysis modelling represents a vitally important aspect of planning in both the private and public sectors (Murray, 2003). ReVelle and Eiselt (2005)

describe four components of location analysis problems: potential facility users who are located at points or on routes, facilities or services that are to be located, a space in which potential facility-users and the facilities are located, and a metric that indicates distances or travel-times between users and facilities.

Location analysis models are employed to examine various objective functions which describe the goals that the modeller is seeking to achieve. Common objectives that provide the motivation for conducting location analysis models include; cost minimization, profit maximization, maximizing the number of people who can access a facility, and reducing the friction of distance related to travelling to a facility (Malczewski, 1999; McLafferty, 2003).

The GIS environment provides a multitude of options for location analysis modelling. The variety of techniques available, coupled with the visual interface and output capabilities of GIS make it a robust platform for examining location suitability (Church, 2002). Data overlays and methods that combine suitability criteria or examine multiple objectives are commonly applied because of their flexibility and ability to integrate various factors and constraints that indicate the suitability of locations for a given purpose (Malczewski, 2004). GIS-based location analysis techniques have been used to examine location suitability in diverse fields including business, retail and marketing, environmental resource management, land-use zoning, and health and social service allocation (e.g. Alçada-Almeida *et al.*, 2009; Barnett & Okoruwa, 1993; Benoit & Clarke, 1997; Ranta, 2005; Yeh & Chow, 1996).

Daskin and Dean (2004) classify health care location analysis models into three broad categories of purpose; *accessibility*, *adaptability*, and *availability* models.

Accessibility models are used to determine appropriate facility or service locations, with regard to the distribution of the study population in relation to the facility or set of facilities. The aim is to maximize coverage in an area and to minimize distance to the service provider. Adaptability models consider future consequences by attempting to find solutions that achieve positive results across a range of future scenarios; these are particularly appropriate for large, expensive, and irrevocable facility siting endeavours. Availability models are focused on immediate access to a facility or service, and are most commonly applied to the availability of emergency services in facility overloading situations.

1.5 Thesis Outline

This thesis is comprised of four chapters. The bulk of the thesis (Chapters 2 and 3) is comprised of two studies that were published in peer-reviewed journals separately. The studies roughly correspond to the three stated thesis research questions; the first and second research questions are the focus of Chapter 2, and the third question is examined in Chapter 3.

Chapter 1 has been a review of concepts central to the research. The purpose of this chapter was to introduce the reader to current issues concerning palliative care, health care access and delivery, and the use of GIS in evidence-based health service planning.

Chapter 2 addresses the first and second research questions of this thesis through an examination of the spatial distribution of palliative care services, service accessibility, and the identification of populations, communities, and regions of British Columbia that

are under-served. In addition, appropriate background information introduced in Chapter 1 is discussed in greater depth, and concepts relevant to the chapter are examined including specialized palliative care.

Chapter 3 addresses the final research question by examining the suitability of communities in un-served regions of British Columbia as new host sites of palliative care delivery. This possibility is assessed through development and implementation of an accessibility-based location analysis model. A core contribution of this thesis is described in detail in this chapter; the strategically located secondary palliative care hub as a novel concept for enhancing access to a wide-range of palliative care services in rural and remote regions. Results illuminate the most appropriate secondary palliative care hub locations in British Columbia.

Chapter 4 reflects on the purpose, methods, results, and recommendations of the thesis. The overall contributions are described, followed by a discussion of potential future directions for research in palliative care and resource allocation.

CHAPTER 2

A METHOD TO DETERMINE SPATIAL ACCESS TO SPECIALIZED PALLIATIVE CARE USING GIS¹

2.1 Abstract

Providing palliative care is a growing priority for health service administrators worldwide as the populations of many nations continue to age rapidly. In many countries, palliative care services are presently inadequate and this problem will be exacerbated in the coming years. The provision of palliative care, moreover, has been piecemeal in many jurisdictions and there is little distinction made at present between levels of service provision. There is a pressing need to determine which populations do not enjoy access to specialized palliative care services in particular. Catchments around existing specialized palliative care services in the Canadian province of British Columbia were calculated based on real road travel time. Census block face population counts were linked to postal codes associated with road segments in order to determine the percentage of the total population more than one hour road travel time from specialized palliative care. Whilst 81% of the province's population resides within one hour from at least one specialized palliative care service, spatial access varies greatly by regional health authority. Based on the definition of specialized palliative care adopted for the study, the Northern Health Authority has, for instance, just two such service locations, and well over half of its

¹The following chapter has been published in *BMC Health Services Research* under the co-authorship of Nadine Schuurman and Valorie A. Crooks.

population do not have reasonable spatial access to such care. Strategic location analysis methods must be developed and used to accurately locate future palliative services in order to provide spatial access to the greatest number of people, and to ensure that limited health resources are allocated wisely. Improved spatial access has the potential to reduce travel-times for patients, for palliative care workers making home visits, and for travelling practitioners. These methods are particularly useful for health service planners – and provide a means to rationalize their decision-making. Moreover, they are extendable to a number of health service allocation problems.

2.2 Introduction

Providing palliative care has become a priority for health system administrators worldwide. In many countries, existing palliative care service delivery is inadequate and challenged by population aging, resulting in strained services that are increasingly unable to keep up with demand (Brennan, 2007; Carstairs, 2005; Pease & Dorman, 2007; Torgerson *et al.*, 2006). There is also growing realization that the development of palliative care services in many jurisdictions has been piecemeal, unplanned, and largely unregulated which has ultimately exacerbated disparities in access to receiving care by geographic location and socio-economic status (Beccaro *et al.*, 2007; Currow *et al.*, 2004; Wood *et al.*, 2004). At the same time, it is recognized that initiating palliative care for a patient with a life-limiting illness can reduce the burden placed on health care systems through freeing up space in acute care settings and halting curative treatments when the prognosis becomes terminal (Stjernsward *et al.*, 2007a). Furthermore, it is recognized that patients should have the right to receive care that is appropriate to their needs (Cancer Care Ontario, 2006; Carstairs & Beaudoin, 2000; World Health Organization, 2007) and

not be limited to simply what is available. As a result of these factors, health systems in Canada and worldwide are starting to recognize the need for improved palliative care delivery (Beccaro *et al.*, 2007; Health Canada, 2007; World Health Organization, 2007; Wu *et al.*, 2006).

The equitable provision of health care services (i.e., care that is offered in a fair and just manner based on need) in an accessible fashion is a primary concern for health planners; however, ‘access’ can be defined in many different ways. Access to health services can, for example, refer to: availability in terms of socio-economic status or geographic location, the availability of information, wait-list times, and quality of services offered (Goddard & Smith, 2001; Torgerson *et al.*, 2006; Wilson & Rosenberg, 2004). Health systems must therefore take into account various aspects of accessibility when planning service delivery. Recognition that health care services are not equally or equitably accessible by all has started to drive policy making in palliative care (Ahmed *et al.*, 2004). In British Columbia (BC), the most western province in Canada, there is increasing recognition of the need for better spatial access to palliative services for all residents. A recent framework for end-of-life care created by the BC Ministry of Health outlines a commitment to “establishing high quality end-of-life care and support as an integral part of our provincial health system” (Government of British Columbia, 2006, p. 5). The need for palliative services to be accessible to all residents of the province, and as close as possible to their home location is highlighted. Services located near to palliative care recipients’ home communities will not only improve spatial accessibility for the patient, but will also reduce travel-time for workers making home visits and practitioners that deliver care in multiple communities. The present study examines the spatial

accessibility of palliative care services for the residents of BC by employing a novel spatial analysis approach using Geographic Information Systems (GIS). The study focuses on specialized palliative care (SPC) services, but the spatial methodology introduced is relevant to a number of health service allocation problems in multiple jurisdictions.

2.2.1 Spatial Accessibility of Palliative Care

The influence of location and distance to health services on health outcomes are well documented (Cloutier-Fisher *et al.*, 2006; French *et al.*, 2006; Guagliardo, 2004; Lovett *et al.*, 2002). Home location has been shown to determine access to and utilization of health services, with utilization being inversely related to spatial access (Cloutier-Fisher *et al.*, 2006; Goddard & Smith, 2001; Mobley *et al.*, 2006). Furthermore, it has been argued that a person's home location can also be a determinant of his/her overall level of health (Field & Briggs, 2001). Thus, people who reside closer to sites of care delivery are more likely to utilize these services and obtain better health outcomes as a result. Spatial proximity to health care services particularly affects the elderly and younger populations, individuals with physical and mental impairments, and those residing in rural and remote areas through reduced mobility associated with these populations (British Columbia Hospice Palliative Care Association, 2005; Connor, 2007; Mobley *et al.*, 2006; Nemet & Bailey, 2000).

Canadian health organizations have expressed the need to research the geographic and demographic factors that influence palliative care delivery and uptake (Davies & Higginson, 2004; Government of British Columbia, 2002). GIS-based analyses can provide robust decision support for health service studies by uncovering the geographic

and demographic determinants of service utilization. An increasingly popular use of GIS in this realm is to determine the spatial accessibility of services based on distance or travel-time from residence to site of care. Straight-line and road-network based measures of distance from residence to site of care have been used in the past to measure accessibility. However, these methods are inappropriate for modelling access in large regions like BC because of the geographic diversity characterized by mountain ranges, valleys, meandering coastlines, and a mix of urban centres and rural hinterland. Various methods of measuring travel-time have been used in modelling spatial accessibility to health care services (see Brabyn & Skelly, 2002; Fone *et al.*, 2006; Hare & Barcus, 2007; Jordan *et al.*, 2004; Lovett *et al.*, 2002; Schuurman *et al.*, 2006). Haynes *et al.* (2006) validated the use of travel-time to measure spatial accessibility by comparing a GIS-based travel-time model with actual driving time to service locations. Results were highly correlated for modelled and actual travel-time to health care service locations.

In Canada, provincial health systems are obligated to ensure access to health services for all citizens, based primarily on the principles of ‘universality’ and ‘accessibility’ which are enshrined in the Canada Health Act (Wilson & Rosenberg, 2004). GIS methods allow for evidence-based planning that can promote universally accessible health care services. In this study we determine the current spatial accessibility of palliative care services in BC using a proven vector GIS catchment method (Schuurman *et al.*, 2006). This method is appropriate for studying access to health services in geographically diverse regions such as BC because it is based on road network travel-time from home to location of care. This study presents a description of those areas of BC that are within one hour travel-time to SPC services and the proportion of the

population that existing services are reaching. Identification of communities that are greater than one hour from services is provided to shed light on possible locations where new palliative services could be implemented to service rural and remote areas in particular.

2.2.2 Specialized Palliative Care

There is no single, universally accepted understanding of what palliative care services or practice entail (McNamara *et al.*, 2006; Wu *et al.*, 2006). This has contributed to wide disparities in the resources, capacity, and infrastructure devoted to palliative care delivery (Brennan, 2007), and poses questions and challenges for palliative care research. As such, diversity is a hallmark of palliative care, evidenced by the range of treatments, sites of delivery, and populations eligible for care. Traditionally palliative care was directed at relieving pain in patients with cancer in the final stage of illness, though increasingly it is becoming available to those who require care for longer periods at end-of-life as well as those with non-cancerous conditions (Evers *et al.*, 2002; Field & Addington-Hall, 1999; Pease & Dorman, 2007; Skilbeck & Payne, 2005). The type of palliative care delivered varies from pain management and comfort care to therapies and spiritual counselling (Saunders, 2000). Counselling, bereavement services, and respite care for patients' families have also entered the palliative care service basket. Palliative care can be delivered by specialized practitioners, general practitioners, allied health professionals, and informal caregivers such as volunteers and family members (British Columbia Hospice Palliative Care Association, 2005). The care itself can be delivered in hospice residences, acute care settings, care facilities, and patients' homes (Government of British Columbia, 2006).

The vagaries associated with palliative care can act as roadblocks to the effective promotion and delivery of quality end-of-life care (Meghani, 2004). What is needed, then, is an inclusive definition. Definitions posited by the World Health Organization (WHO) have been refined several times, mirroring the increased attention on end-of-life issues. The current WHO definition (Sepulveda *et al.*, 2002) is as follows:

Palliative care is an approach that improves the quality of life of patients and their families facing the problems associated with life-threatening illness, through the prevention and relief of suffering by means of early identification and impeccable assessment and treatment of pain and other problems, physical, psychosocial and spiritual.

Based on suggestions from the European School of Oncology, Ahmedzai *et al.* (2004) refined the WHO definition in a way that could help to improve both service delivery and research into palliative care issues. Palliative care can be usefully subdivided into basic and specialized categories (p. 2194).

Basic palliative care is the standard of palliative care which should be provided by all healthcare professionals, in primary or secondary care, within their normal duties to patients with life-limiting disease.

Specialised palliative care is a higher standard of palliative care provided at the expert level, by a trained multi-professional team, who must continually update their skills and knowledge, in order to manage persisting and more complex problems and to provide specialised educational and practical resources to other non-specialised members of the primary or secondary care teams. If a patient has difficult symptoms which cannot be controlled by his/her current healthcare team, he/she has a right to be referred, and the current healthcare provider has an obligation to refer, to the local palliative care team.

This distinction between basic and specialized care is useful to categorize the different types of care and locations of palliative care service delivery. Care that is delivered by general practitioners, some allied health professionals, and informal caregivers in home and acute care settings can be considered basic palliative care. Multi-focal care which is delivered by a multi-disciplinary team with some palliative care specialization in a variety of settings including the home constitutes SPC. Patients receiving SPC often have access to a wider variety of specialist treatments and support, from comfort care to intense pain management, while their families can access a host of services that can include respite care, counselling and bereavement services. These services are provided by specially trained experts, which helps to ensure the best possible quality of death and dying for patient and support for the family during the palliative stage.

Albeit not definitive, studies have found that SPC is more effective at improving patients' quality of life in their final days than basic palliative care (Corner *et al.*, 2003; Jack *et al.*, 2006; Salisbury *et al.*, 1999). Also, a study by Morita *et al.* (Morita *et al.*, 2006) found that bereaved family members of cancer patients who had received SPC were happier with the services provided compared with those who had not. Furthermore, general practitioners have acknowledged the benefits of SPC and favour referring a dying patient to a specialist at the end-of-life if this service is available (Pereira, 2005; Shipman *et al.*, 2002). Ensuring access to SPC for palliative care recipients should be prioritized because it stresses education for all stakeholders and the right to expert care for all as a human right (Brennan, 2007). Reasons for establishing and/or enhancing SPC are well-grounded and the benefits have been demonstrated; however, it is impossible to have

palliative experts in all communities, especially in rural and remote areas. According to the SPC model, specialists should deliver palliative care whenever possible, but in communities where SPC is not feasible, local general practitioners and informal and voluntary-sector caregivers should be trained in specialized methods.

The purpose of this study is to model spatial accessibility to palliative care in British Columbia using the SPC definition. Accessibility is determined through calculating the proportion of the total population that is within a reasonable travel-time to a SPC location. Also, geographically distant communities without SPC services are highlighted as potential candidate locations to provide SPC to surrounding rural and remote areas. The SPC definition was chosen because it provides a standard of comparison for future spatial analyses of palliative care services in other countries and regions. Furthermore, it provides a framework for our future research goals of determining appropriate locations for siting regional hubs of palliative care to serve the rural and remote regions highlighted by this study. These hubs will boast multi-professional teams to deliver SPC and will have the ability to educate local practitioners and caregivers in remote areas to provide good-quality basic palliative care where SPC is not feasible.

2.3 Methods

This study calculates the service areas or catchments of existing SPC locations in BC and the populations within those service areas. At the same time, the study identifies and calculates populations outside one hour to SPC. In addition, proportions of the population within and without the service catchments are calculated. The locations of current SPC services in the province were collected by directly contacting each of the

five regional health authorities. The locations that adhered to this definition included hospice residences and designated palliative care units within hospitals with a minimum of five beds. Five beds was considered the minimum for a hospital palliative unit because it was expected that this would also mean the unit would have access to a multi-disciplinary team of palliative experts. Some smaller hospitals in BC set aside one or two beds for palliative patients on an as-needed basis, though care for these patients is typically provided by non-specialized volunteers and practitioners, and as such, do not meet the criteria for SPC. Thus, the number of beds was used as a proxy indicator for the presence of an on-site multi-disciplinary team of palliative care specialists and not an indicator of palliative care supply.

Locations of SPC services in each of the five BC health authorities were geocoded and mapped using ArcGIS 9.2 (ESRI, 2006). To create the service areas for each location, network-based travel-time catchments were created using the Network Analyst extension in ArcGIS, based on a proven travel-time catchment method (Schuurman *et al.*, 2006). Such an approach is part of an established literature on the use of travel-time to measure spatial accessibility (see Brabyn & Skelly, 2002; Hare & Barcus, 2007; Jordan *et al.*, 2004; McGregor *et al.*, 2005). The Road Atlas of BC dataset from GIS Innovations was used to provide travel-time measurement along road networks. This extensive road dataset includes travel impact variables such as speed limits, road surfaces, and stop signs for each road segment which allows for an accurate prediction of travel-time between any two points in the province that are connected by the road network. Catchments were created based on a travel-time of one hour to service location. One hour travel-time was chosen as it reflects a reasonable daily commute to and from

sites of care for palliative care workers and informal caregivers, because permanent relocation to urban areas is inconsistent with the wishes of those with a life-limiting illness or their families (Gilbar & Steiner, 1996).

To determine the population within each catchment, a spatial query method was employed using census block-level population data (Statistics Canada, 2002), the finest-scale at which population data is available in Canada. The total population of all individual Census Block geographic units within a maximum distance of 2500 metres from the catchments were summed to determine the total population that is within one hour drive to service locations. Schuurman *et al.* (2006) describe the catchment creation and population linking procedures in greater detail in a study of access to hospitals in BC. Communities outside of the one-hour service areas were highlighted using a spatial query that selected all census-defined Urban Areas (communities with at least 1000 residents, with a population density of at least 400 people per km²) that had centroids within 2500 metres of the catchments.

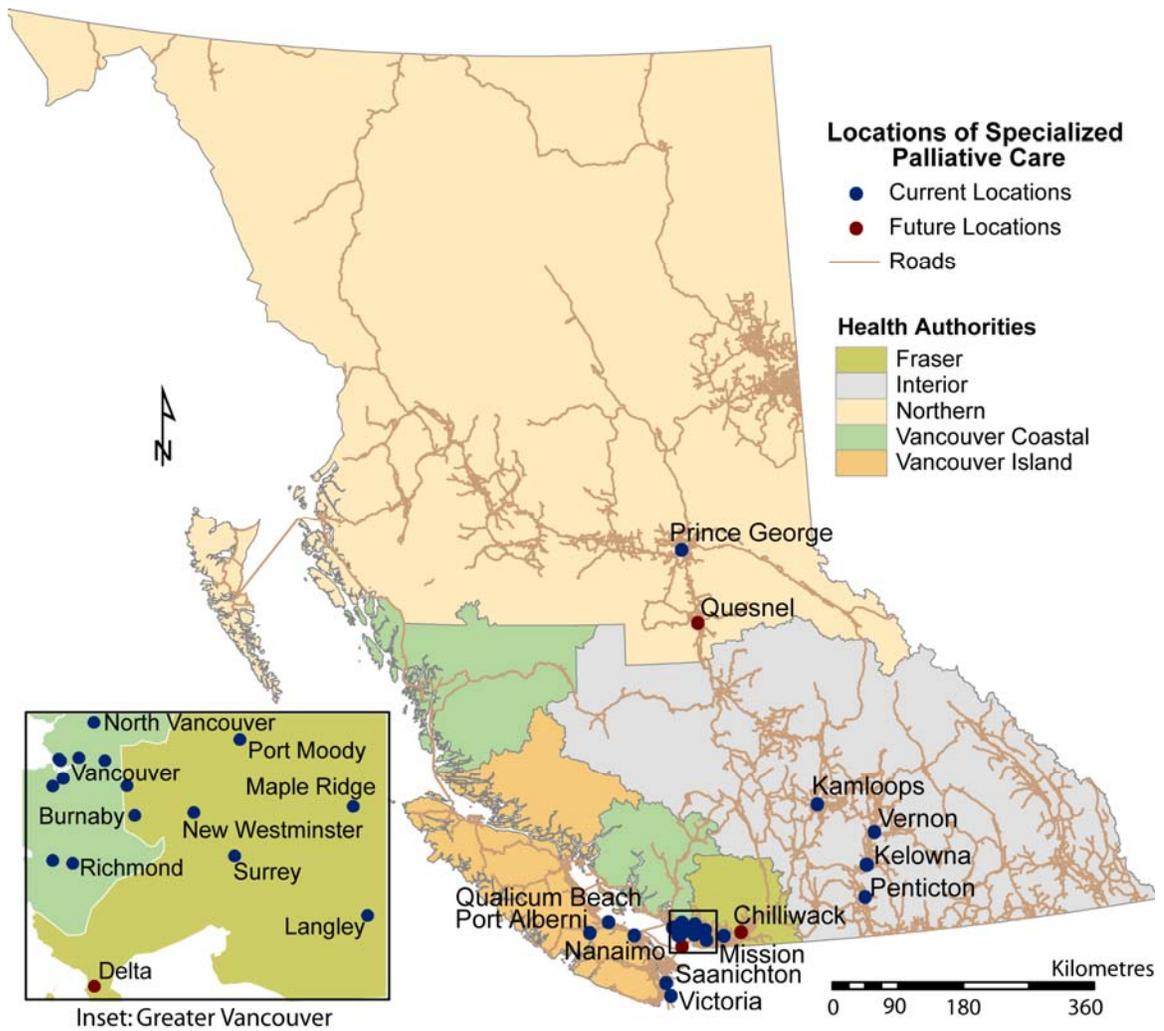


Figure 2-1: Map of British Columbia showing locations where SPC is delivered.

Currently 29 locations in BC offer SPC. Three new locations are scheduled to open in 2008-09.

2.4 Results

According to our working definition at the time of the analysis there were 29 locations where SPC was delivered in BC and three new locations slated to open in the near future. The sites of delivery included hospice residences and palliative care units in hospitals, each with varying capacities. Figure 2-1 shows the communities where SPC services are delivered in BC. One-hour travel time catchments for SPC services are shown in Figure 2-2. Catchments were created for all 29 existing and three future service locations.

Table 2-1: Palliative care locations and population within catchment areas for each health authority

<i>Health Authority</i>	<i>Locations</i>	<i>Total Pop.</i>	<i>Pop. In Catchment</i>	<i>% in Catchment</i>
Fraser	8 (+2)	1,387,010	1,326,967	95.67
Interior	5	683,863	411,150	60.12
Northern	1 (+1)	297,415	107,150	36.03
Vancouver Coastal	10	1,016,380	909,121	89.45
Vancouver Island	5	693,779	582,100	83.90
Total (All of BC)	29 (+3)	4,078,447	3,336,500	81.81

Total population figures from Statistics Canada (2002).

Table 2-1 summarizes the number of service locations and the total population of each health authority. Also shown is the total population and percentage of the population that has access to SPC for each health authority. The results include the three new service locations that are scheduled to open in 2008 or 2009. The Northern Health Authority (NHA) had the lowest proportion of its population within one-hour to SPC at 36%, based on just one existing location in Prince George and one future location in

Quesnel. Just 60% of the Interior Health Authority (IHA) had access to SPC from five service locations. More than 95% of the population of the Fraser Health Authority (FHA) lived within one-hour of its eight current and two future locations. Almost 90% of the Vancouver Coastal Health Authority's (VCHA) population was within an hour drive to SPC based on ten locations. Five locations in the Vancouver Island Health Authority (VIHA) served almost 84% of its total population.

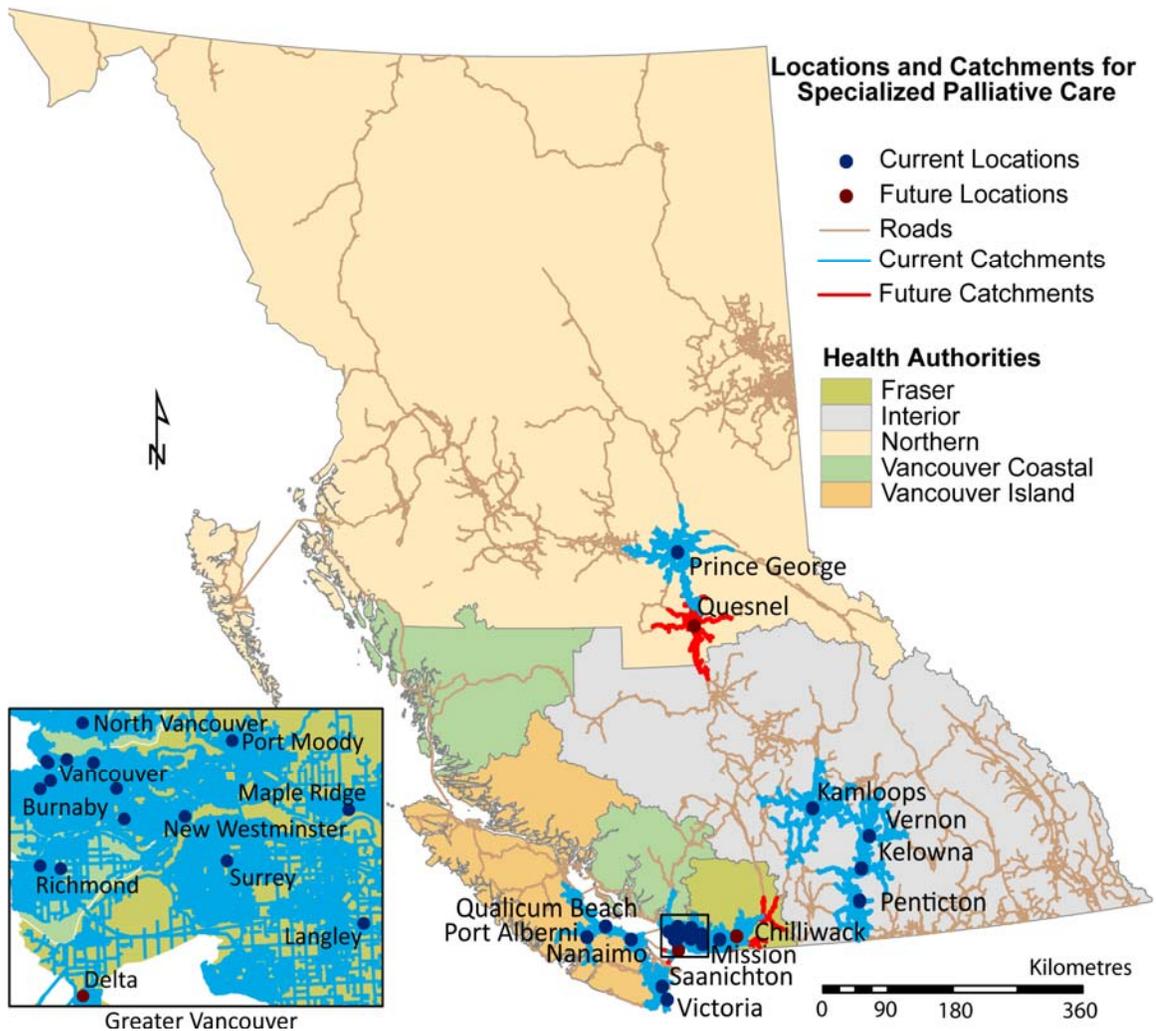


Figure 2-2: One hour travel-time catchments for existing and future SPC locations in British Columbia.

Catchments show the service areas for existing and future services. The farthest reaches of the catchments indicate the location that is exactly one hour drive to the nearest SPC service location.

All of the Urban Areas greater than one-hour from SPC services are highlighted in Figure 2-3. IHA had the greatest number of Urban Areas (25) outside the one-hour catchments. The VCHA had four, VIHA had six, and NHA had 15 Urban Areas that were greater than one hour from SPC. All of the Urban Areas in the FHA were within one hour travel-time to SPC.

Table 2-2: Largest communities greater than one hour to SPC by health authority

<i>Health Authority</i>	<i>Urban Areas</i>	<i>Population</i>
Fraser	N/A	0
Interior	Cranbrook	18,131
	Williams Lake	12,621
	Nelson	9,585
	Trail	9,484
	Revelstoke	8,042
	Castlegar	7,610
Northern	Terrace	17,596
	Prince Rupert	16,633
	Fort St. John	15,021
	Dawson Creek	11,125
	Kitimat	10,551
Vancouver Coastal	Powell River	13,131
	Whistler	7,112
Vancouver Island	Campbell River	31,038

Source: Statistics Canada, 2002.

Several larger regional centres are without access to SPC. Table 2-2 lists the largest communities in each health authority outside of the one-hour catchments. In the NHA, Terrace, Prince Rupert, and Fort St. John each have a population greater than 15,000 and are well outside of the SPC service areas. In the IHA, residents of Revelstoke, Williams Lake, and several larger communities in the Kootenay region are without reasonable spatial access to SPC services, including Nelson, Trail, Castlegar, and Cranbrook. Whistler and Powell River are the largest communities in the VCHA region

that do not have access to SPC. Campbell River, with a population of over 31,000 in the VIHA, sits just outside the existing SPC catchments. Further, several other smaller Urban Areas in more remote parts of Vancouver Island are at a significant spatial disadvantage for accessing such services.

2.5 Discussion

We have undertaken a spatial analysis of spatial access to SPC services in BC. Figure 2-1 reveals that the majority of SPC locations are clustered in the extreme southwest of the province in and around the Vancouver area. This is no surprise given that a majority of the province's population resides in this area. Further, the FHA is recognized as having significantly invested in developing palliative care service infrastructure within its catchment area. The remaining locations are dispersed in the southern half of BC, mainly in larger regional communities.

At first glance, it appears that the spatial accessibility of SPC in BC is reasonably good, with over 81% of the province's population residing within one hour from at least one service location. Whilst this is true, spatial access varies greatly by health authority as illustrated in Table 2-1 and Figure 2-2. The NHA has the lowest population base, but it is spread over the largest geographic area. With just two SPC locations, well over half of its population do not have reasonable spatial access to such care. The situation in the IHA is similar with just over half of its population enjoying access to SPC. Most of the residents in the VCHA and FHA are within an hour drive to one or more SPC sites. Relatively good spatial access to SPC in these two heavily populated health authorities skews the overall rate to make it appear that access is reasonably good for the province as a whole.

By determining areas that are outside of the catchments, we can identify regions for which health system administrators should consider siting further SPC services in the province. Figure 2-3 highlights the Urban Areas in BC that are without spatial access to SPC services, specifically those located greater than one-hour of driving time away from

sites. Of the 93 Statistics Canada defined Urban Areas that exist in BC, 50 are greater than one hour from the nearest service location. Evidenced by the above analysis, NHA and IHA communities are particularly burdened by unequal spatial access to SPC. The communities listed in Table 2-2 are potential candidates for situating future SPC services. The largest communities are most suitable because a large and stable core population is needed in order to ensure enough demand and also justify expenditures. Specifically, larger communities such as Prince Rupert in the NHA, and Cranbrook or Campbell River in the IHA are the most likely candidates based solely on their core population sizes. Surrounding populations must also be taken into consideration when analyzing site suitability in order to achieve economies of scale. Several clusters of larger communities are evident in Figure 2-3. Clustering is apparent in the north-west NHA, including Prince Rupert, Terrace, and Kitimat, and in the north-east with Dawson Creek, Fort St. John, and Chetwynd. The Cranbrook-Fernie-Kimberley and Nelson-Castlegar-Trail areas in the Kootenay region of the IHA are in close proximity to each other. Installation of SPC in one community in each cluster would likely ensure spatial access to SPC for the residents of all of the nearby communities and rural areas. The next stage of this research is to assess the suitability of these sites for situating SPC services. The age structure and other relevant socio-demographic characteristics of each community will be taken into consideration to create a robust index of site suitability based on potential need.

2.5.1 Limitations

Use of the SPC definition care may discount the efforts of informal caregivers and non-specialized types of care which also likely benefit the patient at the end-of-life. However, despite focussing on specialized care, this study does acknowledge the need for

basic palliative care in some communities where SPC is not available or feasible. Another potential limitation was the fact that the supply side was considered to be equal among centres, and demand for SPC was not addressed. Several GIS modelling types are available which take supply and demand into consideration; however, these methods are not appropriate for palliative care. Supply is usually measured as the number of care beds or number of physicians. As palliative care consists of a diverse set of therapies and interventions delivered in a multitude of settings, it is likely impossible to determine the exact supply of services for any given area. In terms of demand, we assumed the whole population of the study area to be potential users of SPC. This is a reasonable assumption given that this type of care is now targeting all age groups; the only restriction is that a patient must have a life-limiting condition.

Possible limitations regarding the use of one hour as a reasonable travelling time to services are apparent. This travel-time was chosen because of its importance within emergency services as the 'golden hour', the period of time in which patients in need of emergency care should arrive at hospital to minimize the risk of serious consequences (Crews & Holbrook, 2005; Raghavan & Marik, 2006). One hour has been used in other GIS-based spatial analyses of travel-time to health services in large regions (Brabyn & Skelly, 2002; Schuurman *et al.*, 2006). Furthermore, a sensitivity analysis helped to confirm the appropriate choice of catchment size for this study. Catchments based on a 90 minute travel-time captured less than 2.9% (minimum 0% in FHA, maximum 8% in VIHA) more of the province's population overall compared with the 60 minute catchments. The original 60 minute catchments captured over 5.5% (minimum 0.6% in FHA, maximum 18.6% in VIHA) more than 30 minute catchments. Thus, the sensitivity

analysis was useful in confirming our choice of one hour as the threshold for this study, as the increase in population was greater from 30 to 60 as opposed to the smaller gain from 60 to 90 minute catchments. True, larger catchments would likely suggest greater spatial accessibility, though the longer commute is an increased burden for palliative patients who wish to spend their remaining days at home, and the smaller increase in population gain renders larger catchments less appropriate as a measure of accessibility in this study. The other limitation with creating catchments based on a strict travel-time threshold is that spatial access drops to zero just outside the catchment. This is the case in Campbell River which is located just outside a catchment. In reality, this community may be serviced by the SPC locations in Port Alberni, Qualicum Beach or Nanaimo. Additionally, solely considering spatial access oversimplifies a diverse concept. Despite the potential limitations, this study provides a useful analysis of the distribution of SPC in BC, the population of BC that can reasonably spatially access SPC, and has highlighted several communities where SPC implementation may benefit rural and remote regions.

2.5.2 Implications

It is likely that numerous individuals at end-of-life living in communities significantly outside of the one-hour catchments either die without receiving SPC, are forced to commute an unreasonable distance to get to non-local/regional service sites, or relocate to larger urban centres that have existing SPC. Relocation, however, is often against the wishes of patients and their families and runs counter to the trend of ageing-in-place in rural and remote BC communities (Hanlon & Halseth, 2005). Furthermore, it is acknowledged that dying at home or in one's home community is preferred by a majority of people (Brazil *et al.*, 2005; Higginson & Sen-Gupta, 2000; Howat *et al.*,

2007). The need for easily accessible SPC is further heightened by the move towards providing palliative care on day visits and short-term admissions for symptom control and not as a form of residential care (Eve & Higginson, 2000; Ingleton *et al.*, 2003; Lynne *et al.*, 2000; Riechelmann *et al.*, 2007; Skilbeck & Payne, 2005; Zimmermann *et al.*, 2006). Therefore, reasonable daily travel to and from a SPC site for the care recipient and his/her family, or to-and-from the patient's home or home community for a SPC professional, is crucial. If a patient is accepted into a hospice residence or other residential service site (e.g., acute care hospital), it is vital that family and friends be able to travel regularly to visit and provide comfort in his/her final days. Finally, if a patient is able to remain at home during his/her final days and requires only minimal therapeutic intervention (e.g., pain management, wound care), it is imperative that service providers are available within a reasonable travel-time from the care recipient's home to deliver them.

According to our model, close to three quarters of a million people in BC (almost 20%) lack access to SPC, and in general, spatial access is non-existent for people who do not live in the Vancouver region or the larger urban centres on Vancouver Island and in the province's interior. Unique challenges exist in delivering a full complement of health and social services in rural and remote BC (Hanlon & Halseth, 2005). Policies are beginning to change as rural and remote regions adopt new models of service delivery that reflect local needs. We acknowledge that implementing SPC in every community is not feasible given resource constraints and the sparse and widely-distributed nature of the BC population. The creation of sub-regional centres is a possible solution to delivery problems in rural and remote regions, if strategically planned (Faguet, 2004; Williams,

1996). Decentralization has occurred throughout BC through devolution of control to the regional health authorities (Frankish *et al.*, 2002; Lomas *et al.*, 1997), though, we argue, this has not led to greater accessibility for many types of services including palliative care. Strategically located sub-regional care facilities could facilitate spatial access to services within a reasonable travel time, and may be better positioned to assess and respond to the unique needs of local rural and remote areas than provincial or sub-provincial resource dissemination centres. In the case of palliative care in BC, sub-regional care facilities could disseminate information and resources to the local region and provide education for patients, families, and general practitioners while being accountable to the larger health authorities. These facilities could also ensure home-based and non-specialized types of palliative care services are of a consistent quality, at least at the local level. This may mean an expansion of the role of current SPC locations (hospice residences and palliative care units) to include regional regulation and educational capacities. New facilities should be developed with this holistic approach in mind that includes delivery, education, and regulation of SPC.

2.6 Conclusions

Providing equitable spatial access to good quality palliative care is a growing priority for health systems worldwide. Distance and location in part determine utilization of services and influence health outcomes. Unique challenges for palliative care delivery exist in BC as a result of the large rural and remote areas where services are often limited, and distance to locations with specialized services are great. GIS methods can be used to model health service catchments, thereby highlighting the populations that have access to care. This study used a vector GIS-based method to identify areas of BC that are within

one hour travel-time to SPC services and the proportion of the population in each provincial health authority that existing services reach. A working definition of palliative care was formulated to facilitate the modelling and analysis, and to promote further spatial analyses of palliative care. Also described were the communities that are more than one hour from services.

Using the working definition, 29 existing SPC and three future locations (hospice residences and palliative care units) were identified. Creation of catchments for all 32 locations illustrates that over three-quarters of BC's residents are within one-hour drive to SPC. However, distribution varies greatly by health authority, ranging from just 36% in the NHA to 95% in the FHA. A majority of the communities outside of the one-hour catchments are located in either the NHA or IHA. The larger (e.g., Cranbrook, Campbell River, Terrace, Fort St. John) and more clustered communities (north-west, north-east, south-east) are posited to be potential locations where new SPC services could be implemented to improve spatial access for those residing in local rural and remote areas. Current and future locations of such services should focus on delivery, education, and regulation of SPC.

Strategic location analysis methods must be developed and used to accurately locate new SPC services to in order to provide spatial access to the greatest number of people. Specifically, more research is needed into the factors and constraints that ultimately determine the suitability of locations to host SPC than what is provided in the present study. Characteristics of future locations that should be considered include: the presence of other health services and infrastructure, availability of support services, and

population demographics, among other factors. Such consideration will work to ensure that limited health resources are allocated wisely.

Whilst the information gleaned from this study is important for planning of palliative care services, the methodology is also extendable to other health services. It provides a means of rationalizing service allocation based on maximizing the number of people served within a designated road travel time.

CHAPTER 3

ASSESSING THE SUITABILITY OF HOST COMMUNITIES FOR SECONDARY PALLIATIVE CARE HUBS: A LOCATION ANALYSIS MODEL²

3.1 Abstract

An increased need for palliative care has been acknowledged world-wide. However, recent Canadian end-of-life care frameworks have largely failed to consider the unique challenges of delivery in rural and remote regions. In the Canadian province of British Columbia (BC), urban areas are well-served for specialized palliative care; however, rural and remote regions are not. This study presents a location analysis model designed to determine appropriate locations to allocate palliative care services. Secondary palliative care hubs (PCH) are introduced as an option for delivering these services in rural and remote regions. Results suggest that several BC communities may be appropriate locations for secondary PCHs. This model could be applied to the allocation of palliative care resources in other jurisdictions with similar rural and remote regions.

² The following chapter has been published in *Health and Place* under the co-authorship of Nadine Schuurman and Valorie A. Crooks.

3.2 Introduction

A strong commitment to palliative care has emerged in the few decades since its modern inception (Meghani, 2004; Saunders, 2000). As populations age, the provision of appropriate care for terminally ill individuals, their carers and their families has become a priority (Pease & Dorman, 2007; World Health Organization, 2007). Needed palliative care, however, may not be reaching all those who could benefit from it (Ahmed *et al.*, 2004; Brennan, 2007; Stjernsward *et al.*, 2007b; World Health Organization, 2007). In Canada, recent government reports have pointed to a scarcity of palliative care services (Carstairs, 2005; Carstairs & Beaudoin, 2000; Romanow, 2002b). A shortage of available services (e.g., support for in-home care, hospice residences, specialist care) has been exacerbated by the mounting problem of increasingly stretched health care budgets which has amplified the gaps in delivery. An additional problem is that rapid and unplanned development of palliative care services has contributed to confusion over how services are perceived by patients and professionals, resulting in diminished access and utilization (Ahmed *et al.*, 2004). Other challenges include: *heterogeneity* in quality and availability of services across jurisdictions, *lack of understanding* by professionals about referral procedures, *reluctance* by patients and loved ones to accept terminal prognoses, and *misperceptions* that palliative care is reserved for cancer patients only (Ahmed *et al.*, 2004, p. 525).

Health care organizations in Canada are increasingly realizing the extent of the challenge to provide quality palliative care that is accessible to all and have begun to address the situation with the creation of new frameworks for palliative care delivery (Réseau de soins palliatifs du Québec, 2007; Van Den Elzen, 2006). Quality care can be

described simply as care that patients and their families consider to be beneficial and effective. The provision of effective palliative care is a goal of the Province of British Columbia (BC), the westernmost province in Canada (Canadian Institute for Health Information, 2008). The BC Ministry of Health released a framework on end-of-life care in 2006. This framework highlights a commitment to providing high quality end-of-life care “where people live or, if this is not feasible, as close as possible to where they live, in the setting that is preferred by the person and their family and in a timely manner” (Government of British Columbia, 2006, p. 5). What is lacking in this framework and those of many other Canadian provincial and/or regional jurisdictions is an explicit consideration of the particularities of delivering palliative care in rural and remote communities in particular (Crooks & Schuurman, 2008).

The major barriers to the effective provision of optimal and appropriate palliative care are well documented (Bestall *et al.*, 2004; Dudgeon *et al.*, 2007; Van Vorst *et al.*, 2006). Those living in rural and remote regions of jurisdictions are particularly challenged in their access to such care as available health services are often limited or non-existent (Kortes-Miller *et al.*, 2007; Van Vorst *et al.*, 2006; Virnig *et al.*, 2006). Many challenges exist in delivering health and social care in these regions which stem from the two fundamental, interrelated concepts of *access* and *quality of care* (Romanow, 2002a). Communities in rural and remote regions suffer a ‘double burden’-that is, they are subject to both poor accessibility and reduced quality of care due to their geographical remoteness, which is further intensified by decreases in health spending, and a failure by governments to acknowledge their unique circumstances (Halseth & Williams, 1999). Kelley *et al.* (2003) outline the major challenges to delivering palliative care in rural and

remote Canadian regions to include “fewer service providers, geographic isolation, transportation problems, limited funding, lack of service availability, cultural diversity, and a relative concentration of older people” (p.55). All of these challenges are evident in BC, a province with large rural and remote regions, great distances between communities, a sparse and distributed population, and mountainous terrain.

This paper presents a location analysis model that is designed to allocate resources to the most appropriate rural and remote BC communities, with the objective of providing quality palliative care to the greatest number of residents. New modes of health care delivery are needed for rural and remote regions, including for palliative care, in order to address system challenges (Romanow, 2002a). Decentralization of resources and management from distant distribution centres to regional hub communities is a potential solution for improving care delivery through an enhanced ability to provide care that corresponds to local needs and demands (Frankish *et al.*, 2002; Lomas *et al.*, 1997; Mosca, 2006). The present study introduces an evidence-based mechanism to locate secondary palliative care hubs (PCH) in regional communities to improve the delivery of palliative care to rural and remote areas. These secondary hubs will work in conjunction with existing primary PCH that offer specialized care located in large urban centres to provide a more complete network of service. It proposes such hubs to be a novel way to address this particular system challenge. A GIS (Geographic Information Systems) based location analysis model was developed and tested to determine appropriate locations for centralized secondary hubs of care in BC. GIS can provide strong decision support for rationalizing health resource allocation decisions, particularly in large regions such as BC

with diverse topographical characteristics and large distances between communities (see for example Brabyn & Skelly, 2002; McGregor *et al.*, 2005; Schuurman *et al.*, 2006).

3.2.1 Palliative Care Hubs: An Overview

Specialized palliative care (SPC) is defined as “a higher standard of palliative care provided at the expert level, by a trained multi-professional team, who must continually update their skills and knowledge, in order to manage persisting and more complex problems and to provide specialised educational and practical resources to other non-specialised members of the primary or secondary care teams” (Ahmedzai *et al.*, 2004, p. 2194). Concentrating expertise in multidisciplinary teams that work out of hospitals, hospices, or within the community is a common model for delivering palliative care (Davies & Higginson, 2004). SPC is what is provided in existing primary PCHs in BC that are located in larger urban centres that typically host hospice residences and/or a dedicated hospital-based palliative care unit.

Research on palliative care provision has shown that a multidisciplinary palliative care team can most effectively address the needs of patients and their families (Kelley *et al.*, 2003). It is argued that multidisciplinary teams can improve: the speed of referrals and of primary care integration, the co-ordination of different types of care, the communication from care professionals to patients and their families, and the satisfaction of patients and families (Hearn & Higginson, 1998). A study of the factors that affect the place of death (McNamara & Rosenwax, 2007) found that recipients of community-based SPC were seven times more likely to die in their home, the preferred location for a large majority of people at the end-of-life. Above all of this, there is evidence that multidisciplinary teams which have the ability to offer SPC are often better equipped to

improve the quality of death and dying for those with a terminal illness and their families than generalists (Hearn & Higginson, 1998; Higginson *et al.*, 2003; Jack *et al.*, 2006; Morita *et al.*, 2006). In rural and remote areas, service centralization is necessary as implementing multidisciplinary SPC in every small community is not an option given financial and personnel constraints. However, strategically located secondary palliative care hubs in larger, centrally accessible regional communities that focus on enhancing the localized care offered by – mostly non-specialist – rural and remote providers (e.g., nurses, family doctors, social workers, pharmacists) are a potential solution to providing high quality multidisciplinary care in the hinterlands. These secondary hubs should be networked with existing primary PCHs to provide the best possible care to rural and remote populations.

It is envisioned that a secondary PCH will provide care to those surrounding populations that are within a reasonable commute to the service location. Access within a reasonable travel-time for both patient and practitioner is necessary as it has been shown that palliative care recipients typically wish to spend their remaining days at home or in their local communities (Brazil *et al.*, 2005; Canadian Institute for Health Information, 2007; Gilbar & Steiner, 1996; Government of British Columbia, 2006; Higginson & Sen-Gupta, 2000; Howat *et al.*, 2007; McNamara & Rosenwax, 2007). In addition, a secondary PCH could coordinate home care to ensure that consistent and appropriate care is delivered in the patient's home. Wilkes *et al.* (2000) highlight the importance of available information for families of palliative care recipients. Hub locations could also ensure that local residents within the catchment area are aware of the services offered in

their region through undertaking education initiatives and/or developing system navigation tools.

Another important element of palliative care delivery across regions is the development of multidisciplinary provider networks (Dudgeon *et al.*, 2007; van Raak *et al.*, 2008). Secondary PCHs could organize networks of palliative care providers to promote cooperation and co-ordination of services in the local region and also with the closest primary hubs. Palliative care research and auditing of local programs and service delivery could be coordinated through hub locations. Furthermore, these hubs could be centres of training and education for local practitioners and caregivers. Doing so responds to one of the priorities for core end-of-life program development as outlined by the World Health Organization: “develop a reference centre that can provide in-service training to community health caregivers” (World Health Organization, 2007, p. 21). Many hub functions could be facilitated or improved through the use of information technologies. In a systematic review of rural palliative care practice, Evans *et al.* (2003) found that access to specialist care by patients and local caregivers could be improved through linkages enabled by information technology and telemedicine. Norum and Jordhoy (2006) described the effective use of videoconferencing for collaboration between a university oncology department and a satellite palliative care unit in a remote area. In BC, it is envisioned that the proposed secondary hubs will be linked with established primary hubs using these technologies.

3.2.2 A Model to Determine a Community’s Palliative Care Need

Health resource allocation decisions are complex and multifaceted (Fraser & Estabrooks, 2008), and are influenced by the type and quality of services already offered

in an area, the amount of funds available, the time and cost associated with travelling to access services, political influence, population projections, and historical trends in allocation (McLafferty, 2003; Mitton & Donaldson, 2002). In the case of siting secondary PCHs, it is imperative that locations are chosen which reflect the most appropriate use of limited resources (i.e., to benefit the greatest number of people). However, a study involving interviews with Canadian health care decision-makers revealed a lack of consistent evidence-based decision-making for resource allocation (Mitton & Donaldson, 2002). The results of the study suggested that there is a need for “continued research efforts devoted to techniques which aid in evidence-based evaluation of service delivery options” (p. 54). Rational evidence-based decision-making models are useful to determine appropriate resource allocation. A growing number of health care delivery studies are using GIS-based decision-making models to determine where services should be located to best meet population needs (McLafferty, 2003).

A model to calculate a community’s suitability as a secondary PCH was developed, adapted from a trauma facility siting model created by Schuurman *et al.*(2008). As shown in Figure 3-1, the three factors used to calculate site suitability are: the total *population* in the community’s catchment area, the *vulnerability* of the population (measured as the number of residents aged 65 and older in the community), and the travel-time (*isolation*) to the nearest site where care is delivered. This model amplifies the vulnerability of communities with larger numbers of residents aged 65 and older to reflect their increased need for palliative care. The rationale for the choice of these factors is as follows. A large core and regional population is needed to justify expenditures for infrastructure and a networked multidisciplinary palliative care team.

The most isolated communities are thus at a greater disadvantage than communities in closer proximity to a care location simply because of the additional travel-time and travel-costs required to access the services (Guagliardo, 2004). In fact, isolation makes accessing palliative care services and consultation a challenge for both patients and providers (Kelley *et al.*, 2003).

Population vulnerability is an under-assessed determinant of health service need. For palliative care, some un-serviced communities are more vulnerable than others simply because of the disproportionate number of older people residing in the area. In Canada, some communities have a comparatively large population of older people, in part due to their attractiveness to retirees and the process of aging-in-place (Cloutier-Fisher & Skinner, 2006; Hanlon & Halseth, 2005). It is expected that with aging populations and increases in chronic and degenerative illnesses, the need for access to palliative care services by older people will grow steadily in the coming years (Government of British Columbia, 2006; Kelley, 2007). A recent report by the World Health Organization (Davies & Higginson, 2004) illustrated the acute vulnerability of older people at end of life and the unique needs of palliative care recipients in this age group. Older palliative care recipients are increasingly subject to chronic disease co-morbidity and typically manage multiple health conditions (Ahmed *et al.*, 2004; Davies & Higginson, 2004); this suggests a need for access to multidisciplinary palliative care to control a variety of complex problems, including intense pain. The cumulative effect of having multiple health conditions “may be greater than any individual disease, and typically lead to greater impairment and needs for care” (Davies & Higginson, 2004, p. 14). Communities with a greater number of residents aged 65 are more appropriate as locations for palliative

care as the majority of deaths in the developed world occur in people over this age (Davies & Higginson, 2004). In 2004, 78% of all deaths in Canada occurred in this age group (Government of Canada, 2008). Another important consideration is the fact that older people are more likely to have constrained financial resources and fewer close friends and family members to assist with caregiving in comparison with younger individuals (Chenier, 1993; Government of Canada, 2002). Both of these factors inhibit mobility in older people; thus, closely located care facilities in rural and remote communities are required to reduce this additional barrier to accessing appropriate care at end of life.

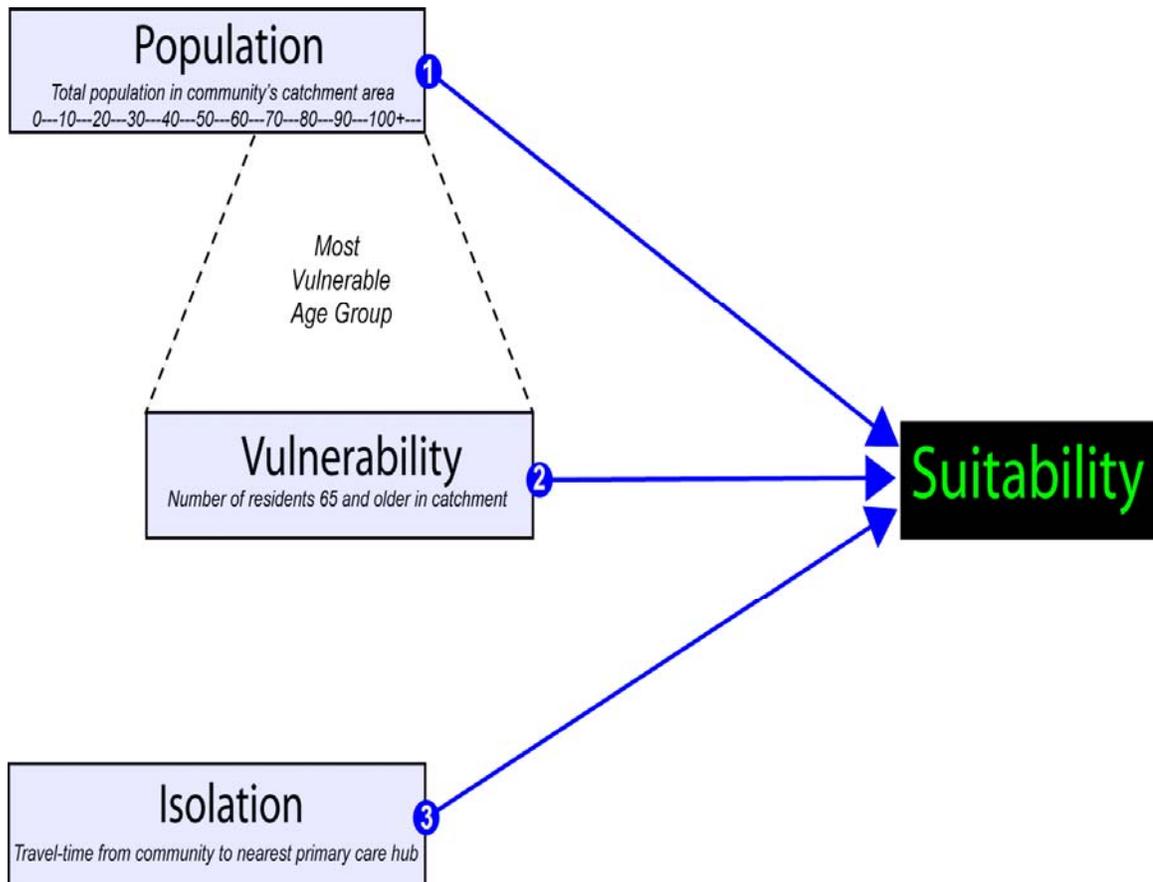


Figure 3-1: Components of the community suitability model.

Three factors are combined to produce an overall index to assess the suitability of a community as a secondary PCH. Population = total population within one hour catchment area. Vulnerability = the number of residents aged 65 and older in the catchment area. Isolation = the travel time to the nearest primary palliative care hub location. This model amplifies the influence of the 65 and older age cohort to reflect the increased need for palliative care for that age group.

3.3 Methods

This study examines the factors and constraints that determine the suitability of a community as a secondary PCH in BC, Canada. Communities that do not have existing SPC services (i.e., those not already serving as primary hubs) were ranked based on the strengths and weaknesses of their characteristics to create an overall index of suitability. These potential secondary PCH communities, and the existing primary PCH locations were outlined in a study by Cinnamon *et al.* (2008). In this previous study, the authors found that larger urban centres in BC were well served by primary PCHs offering SPC, however most rural and remote regions had poor spatial access to SPC but had populations that were too small or dispersed to support a primary PCH. Several constraints determined whether a community met the inclusion criteria in the suitability model. First, the community had to be considered an Urban Area (a Canadian census definition for a community with at least 1000 residents, and a population density of at least 400 people per km²). Second, the community had to possess existing health infrastructure (i.e., a hospital). Third, the community needed to have a population of at least 5000 people. This was to ensure that a basic level of services would be available to support the kind of multidisciplinary network a secondary PCH is envisioned to require. Of 50 potential secondary PCH-hosting rural and remote BC communities just 19 met these criteria, all of which were situated in rural and/or remote areas of the province.

A site suitability model was developed that assessed the three determinants of community suitability for hosting a secondary PCH, namely population, isolation, and vulnerability. The population component refers to the total population living within that

community's one hour travel-time catchment area. Communities with a larger population in their catchment were considered to have greater need for palliative care services. One hour³ was chosen because a care location must be accessible within a reasonable daily commute, as it is well known that palliative care recipients wish to spend their final days at home, as noted above, and service providers must be within a reasonable commute time of those being cared for in the community when undertaking visits to homes and hospices. Greater distances to a hub location will reduce the possibility that the patient can travel for care at this stage of life, and will also limit the potential for the provider to deliver home-based care. The Network Analyst extension in ArcGIS 9.2 (ESRI, 2006) was used to create the travel-time catchments based on a method developed by Schuurman *et al.*(2006). The GIS Innovations Road Atlas of BC dataset was used to create the catchments, as this extensive dataset includes precise travel-times along all segments in the BC road network. To determine the total population residing within each community's catchment area, all Census Block (Statistics Canada, 2002) geographic units (the finest-scale total population data available in Canada) that fell within the catchments were aggregated and summed.

The isolation component of the model was calculated by determining the travel-time from the potential host community to the nearest community with existing SPC services (a primary PCH), based on the assumption that communities more distant from current care locations have greater need for such services. The *near facility* tool available in ArcGIS Network Analyst was used with the Road Atlas of BC dataset to calculate the

³ There is little explicit discussion of reasonable travel time in the palliative care literature. From our ongoing discussions with service providers and administrators and other anecdotal information we have obtained, our use of a one hour time window for travel has been confirmed as sound. The biggest driver for the use of one hour is that much service provision takes place in clients' homes and because of this providers need to be sensitive to the amount of time spent travelling versus providing care.

time it would take to travel to the nearest existing SPC location for all of the 19 potential secondary PCH-hosting communities.

Vulnerability in this model was calculated as the total number of people in the catchment area over the age of 65, based on the assumption that communities with larger numbers of older residents have greater need for palliative care. Thus, the model allows for the greater influence of the 65 and older age cohort in indicating a need for palliative care in a community.

To determine the number of residents aged 65 and older in the community's catchment, all Dissemination Area (Statistics Canada, 2002) geographic units (the finest-scale at which population age cohort data are available in Canada) that fell within the catchments were aggregated and summed.

Linear scale transformation was used to convert the three variables used in the model to a common scale of 0 to 1 using the maximum score procedure (Malczewski, 1999), where higher values indicate greater suitability. Transforming the data to a commensurate scale allows for variables of different types to be compared while retaining the proportional variation between values, and facilitating their compilation into a single index of suitability. This overall index of suitability was created by combining equally-weighted population, isolation, and vulnerability scores assigned to each community, such that the community with the highest overall score was considered the most appropriate location for a secondary PCH.

3.4 Results

Nineteen of 50 communities without existing SPC within a reasonable travel-time (i.e., one hour) were assessed for suitability as potential secondary PCHs. The three factors that together indicate a community's suitability are highlighted in Table 3-1 and Figure 3-2. The total population that would likely use a secondary PCH location for each potential community varied from over 90,000 in the Campbell River catchment to just over 5,000 in the Mackenzie catchment. The communities of Castlegar, Nelson, and Trail in the Kootenay region of the Interior Health Authority⁴ were ranked second, third, and fourth respectively, each having more than 50,000 people in their catchments. In the Northern Health Authority, communities with notable catchment populations include Fort St. John, Dawson Creek, and Kitimat, ranging from over 42,000 to just under 30,000 people.

⁴ In BC health care is administered by regional health authorities. There are five such authorities across the province. As these are meaningful units for health service administrators and decision-makers in the province we refer to them in discussing our findings.

Table 3-1: Factors indicating the suitability of a community for a secondary palliative care hub

<i>Community</i>	<i>Health Authority</i>	<i>Population</i>	<i>Isolation</i>	<i>Vulnerability</i>	
		<i>Catchment Total Pop.</i>	<i>Nearest Primary PCH</i>	<i>Travel-Time(hours)</i>	<i>65+ population (total)</i>
Campbell River	Vancouver Island	90,301	Qualicum Beach	1.3	13,370
Castlegar	Interior	56,982	Penticton	3.5	10,145
Cranbrook	Interior	40,410	Penticton	6.0	5,990
Dawson Creek	Northern	38,741	Prince George	4.5	3,610
Fernie	Interior	33,815	Penticton	7.1	4,495
Fort St. John	Northern	42,449	Prince George	4.9	3,875
Gibsons	Vancouver Coastal	25,624	N. Vancouver	1.5	5,340
Kimberley	Interior	34,131	Vernon	6.3	5,125
Kitimat	Northern	29,987	Prince George	7.3	2,450
Mackenzie	Northern	5,065	Prince George	2.2	145
Nelson	Interior	53,786	Penticton	4.1	9,105
Powell River	Vancouver Coastal	19,109	Qualicum Beach	2.7	3,165
Prince Rupert	Northern	15,485	Prince George	8.4	1,275
Revelstoke	Interior	15,810	Vernon	1.9	3,355
Smithers	Northern	18,995	Prince George	4.4	1,595
Terrace	Northern	20,420	Prince George	7.3	1,645
Trail	Interior	50,784	Penticton	3.8	8,595
Whistler	Vancouver Coastal	27,550	N. Vancouver	1.7	1,640
Williams Lake	Interior	26,476	Quesnel	1.4	3,085

Community isolation as defined by travel-time to the nearest primary PCH is also shown in Table 3-1 and Figure 3-2. Of the 19 communities included in the model, the three most isolated were Prince Rupert, Kitimat, and Terrace, all located in the Northern Health Authority. Each of these communities is between a 7 and 8.4 hour drive to Prince George, the nearest primary PCH location. Several communities in the Interior Health Authority were also located at a significant travel-time to the nearest location of SPC. The most isolated communities in this health authority were Fernie, Kimberley, and Cranbrook, which are all located in the extreme south-east. Campbell River in the

Vancouver Island Health Authority, Williams Lake and Revelstoke in the Interior Health Authority, and Gibsons and Whistler in the Vancouver Coastal Health Authority were all less than a two hour drive to a location where SPC is delivered.

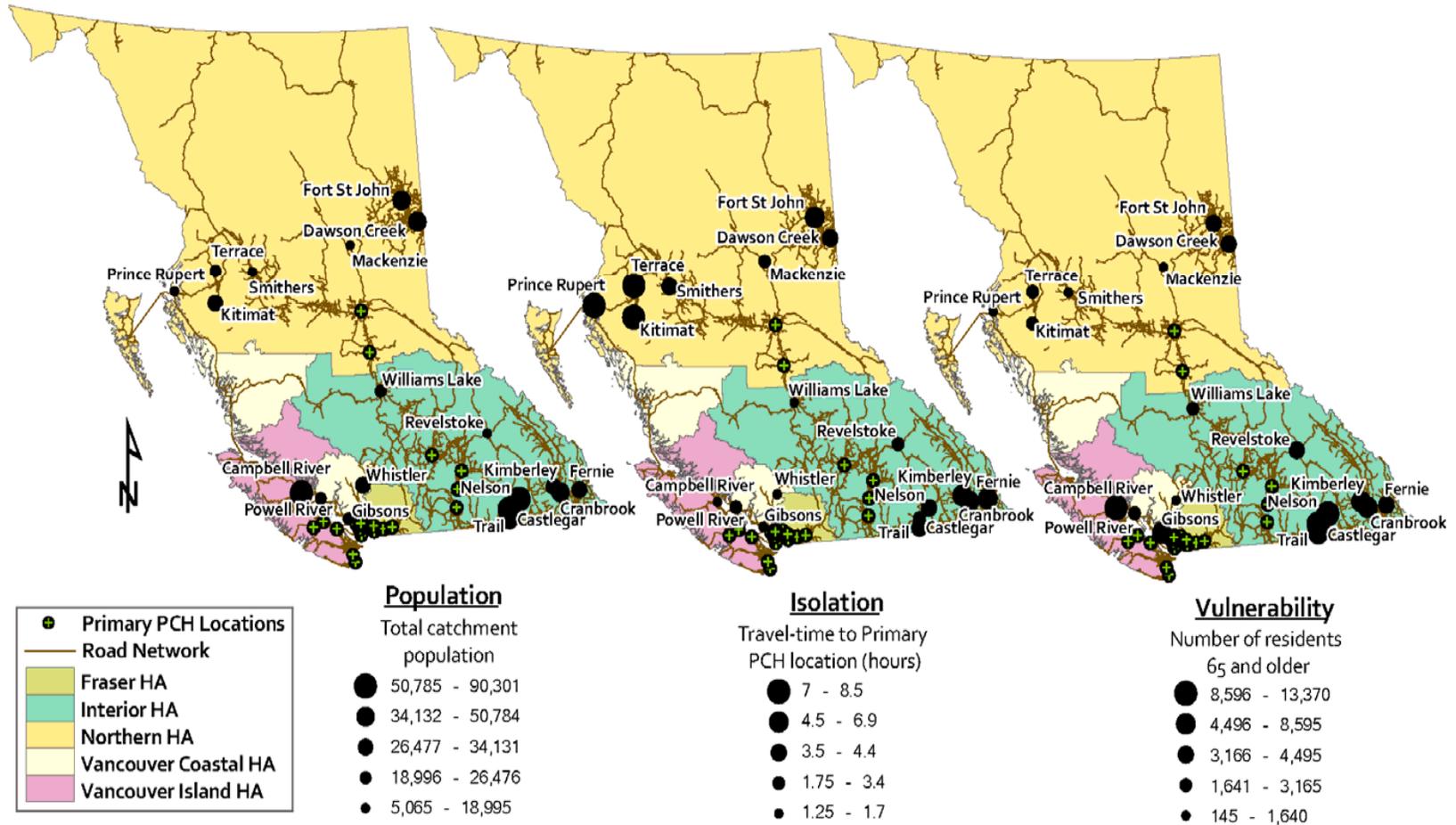


Figure 3-2: Location of current primary hubs and potential secondary hubs.

The results of the three components of the model are shown for each of the 19 potential secondary PCH hosting communities. For example, Campbell River is ranked as high need in terms of population and vulnerability, but is ranked as low need in terms of isolation as it is located just over one-hour from existing primary PCH catchments.

The vulnerability of a community, as measured by the total number of residents aged 65 and older in the catchment, is shown in Table 3-1 and Figure 3-2. The highest ranked community in terms of this factor was Campbell River, with over 13,000 residents in this age group. The three closely situated communities in the Interior Health Authority of Castlegar, Nelson, and Trail were ranked second, third, and fourth respectively for vulnerability. In relation to the other communities in the Northern Health Authority, Dawson Creek and Fort St. John were the most vulnerable, though they were ranked just tenth and eleventh overall for this factor.

Table 3-2: Suitability factor scores and overall rank of potential secondary PCH communities

<i>Community</i>	<i>Health Authority</i>	<i>Population Score</i>	<i>Isolation Score</i>	<i>Vulnerability Score</i>	<i>Overall Score</i>	<i>Overall Rank</i>
Campbell River	Vancouver Island	1.000	0.154	1.000	2.154	1
Castlegar	Interior	0.631	0.420	0.759	1.810	2
Nelson	Interior	0.596	0.490	0.681	1.767	3
Trail	Interior	0.562	0.449	0.643	1.655	4
Cranbrook	Interior	0.448	0.716	0.448	1.611	5
Fernie	Interior	0.374	0.843	0.336	1.554	6
Kimberley	Interior	0.378	0.747	0.383	1.508	7
Kitimat	Northern	0.332	0.874	0.183	1.390	8
Fort St. John	Northern	0.470	0.585	0.290	1.345	9
Prince Rupert	Northern	0.171	1.000	0.095	1.267	10
Dawson Creek	Northern	0.429	0.536	0.270	1.235	11
Terrace	Northern	0.226	0.868	0.123	1.218	12
Gibsons	Vancouver Coastal	0.284	0.174	0.399	0.857	13
Smithers	Northern	0.210	0.527	0.119	0.856	14
Powell River	Vancouver Coastal	0.212	0.320	0.237	0.768	15
Williams Lake	Interior	0.293	0.169	0.231	0.693	16
Revelstoke	Interior	0.175	0.230	0.251	0.656	17
Whistler	Vancouver Coastal	0.305	0.205	0.123	0.632	18
Mackenzie	Northern	0.056	0.266	0.011	0.333	19

Table 3-2 and Figure 3-3 show the population, isolation, and vulnerability scores, and the overall suitability score for each of the potential secondary PCH hosting communities in BC. The results are a ranked list of 19 communities based on their combined scores for each of the three factors included in this model. The overall score highlights the variation in suitability between each community, ranging from 2.15 to 0.33 with higher scores indicating greater suitability. The most suitable community was Campbell River in the Vancouver Island Health Authority with an overall score of 2.15. Six of the top 7 communities were located in the Interior Health Authority. Castlegar (1.81) and Nelson (1.77) were ranked 2nd and 3rd, with Trail (1.65) and Cranbrook (1.61)

rounding out the top 5 most suitable communities. Kitimat (1.39) and Fort St. John (1.35) were the highest ranked Northern Health Authority communities at 8th and 9th overall. The four communities with the lowest overall suitability rank were Williams Lake (0.69), Revelstoke (0.65), Whistler (0.63), and Mackenzie (0.33). The noticeably lower score received by Mackenzie reflects its comparatively small catchment population (5,065), low number of vulnerable residents (145), and relative lack of isolation (2.2 hour drive to primary PCH) in comparison with the other potential secondary PCH communities. Whistler's poor suitability ranking results from a combination of an average population catchment size (27,550), the low number of vulnerable residents living in the Whistler area (1,640), and its location just 1.7 hours from a primary PCH location.

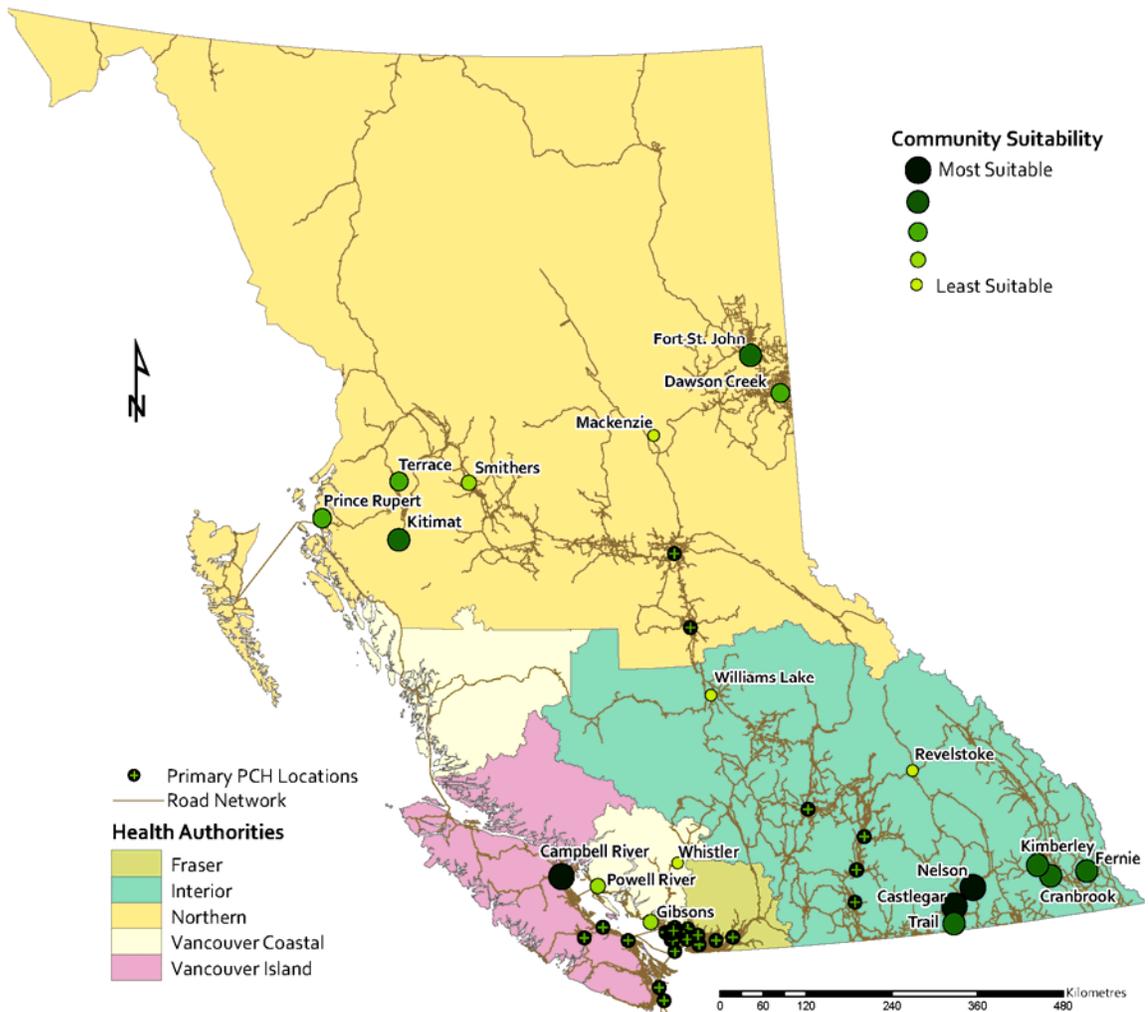


Figure 3-3: Overall ranking of community suitability.

The three most suitable communities to host secondary palliative care hubs according to this model are Campbell River in the Vancouver Island Health Authority, and Nelson and Castlegar, two neighbouring communities in the Kootenay region of the Interior Health Authority. Other notable communities include Trail, Cranbrook, and Fernie in the Interior Health Authority, and Kitimat, Fort St. John, and Prince Rupert in the Northern Health Authority.

3.5 Discussion

This study has described a model that assesses the suitability of communities to serve as secondary PCHs, and tested the model on the potentially suitable locations in rural and remote BC that do not have existing SPC. Campbell River received a noticeably higher overall suitability score compared with the rest of the communities as a result of much higher scores for population and vulnerability. Importantly though, Campbell River received the lowest isolation score as it is located just over a one hour drive to a primary PCH location. As a result of this reasonably good spatial access despite the large population and vulnerability scores, implementing a secondary PCH in Campbell River is probably not an appropriate use of resources. Taking this into consideration, the results of this study reveal that several communities in the Interior Health Authority and Northern Health Authority are in the most need of palliative care and are the most appropriate locations for new secondary hubs. Figure 3-3 reveals that the majority of the most suitable communities are located in the southeast of the province, in particular Nelson and Castlegar, and also Trail, Cranbrook, Fernie, and Kimberley. According to our model, secondary PCHs should be located in one or more of these communities in order to have the greatest impact through making these services accessible to the largest number of potential users. Although less suitable overall, the communities of Kitimat, Fort St. John, and Prince Rupert are the most appropriate candidates for hosting a hub location in BC's north. The context of the Northern Health Authority must be taken into account when interpreting these results. The NHA is characterized by great distances between communities, small populations relative to the other regional health authorities, and just two existing SPC locations in its south. Creation of secondary PCHs in Fort St.

John and Kitimat would improve access in both the northeast and northwest of the Authority in addition to drastically reducing the travel time to the nearest hub location for residents living in the remote far north.

3.5.1 Creating Secondary Palliative Care Hubs

The results of this study provide strong decision support for addressing the commitment made by the BC Ministry of Health in their end-of-life framework (2006) to providing high quality palliative care as close as possible to the home residences of all citizens who may require it. Implementing a secondary PCH in one or more of the recommended communities is a genuine option for addressing this commitment.

A centralized secondary hub should be developed using a holistic approach to care that includes the delivery of palliative medicine, education of local physicians and caregivers in palliative care techniques, social care and support through the integration of spiritual leaders and patient advocates into care teams, and the creation of standards for home-based and generalist care providers. Current sites from which palliative care is already delivered in rural and remote communities could be upgraded to a secondary hub if these extra roles were taken on. The ‘e-hospice’ idea proposed by Kuziemsky *et al.* (2006) is highly compatible with our conception of regional secondary hubs. The authors proposed the idea of the e-hospice as a new mode of care delivery to increase the number of palliative care recipients that can remain at home in their final days. This proposed model of care is designed to improve symptom control at home often without the need for a practitioner to visit, through telemedicine and Web based information technologies. Care delivered in this way could be implemented and managed at the local PCH. Furthermore, insufficient support, manifest in poor coordination of round-the-clock care,

poor communication, inadequate support for carers, and inadequate symptom control can limit the potential benefits of community based care (Amass, 2006). These secondary hubs could help to ensure that support for patients, their carers, and families sufficiently addresses the needs of these groups, thereby improving the capacity to provide quality community based care. Data on usage, including the socio-demographic characteristics and disease types associated with palliative care recipients is currently sparse. These hubs could be charged with data collection and management of palliative care statistics for the local region which would vastly fill this gap in our knowledge base.

Implementation of quality palliative care starts with careful strategic planning (Ferris *et al.*, 2007). Various conceptual models for palliative care programs have been suggested in recent years (Dudgeon *et al.*, 2007; Fainsinger *et al.*, 2007; Ferris *et al.*, 2007; Kortess-Miller *et al.*, 2007; Stjernswärd *et al.*, 2007a). These models largely outline the steps necessary for implementing or expanding palliative care. The model for developing rural palliative care created by Kelley (2007), based on research conducted in Canada, outlines four sequential phases: *antecedent community conditions*, *a catalyst*, *creating the team*, and *growing the program*. This model could be integrated with that of the PCH model and subsequent implementation. The antecedent community conditions identified by Kelley include having sufficient health service infrastructure (a condition of our model), and a vision for improving care to dying people. A catalyst is a person or an event that stimulates change because of the realization that current modes of care delivery are inadequate. The catalyst for the PCH model was the BC Ministry of Health's framework on end-of-life care. The third phase, growing the team, is the next stage in the PCH model. Multidisciplinary networked teams must be organized for each potential hub

location, along with the necessary infrastructure, in order to offer quality palliative care. The fourth and final phase, growing the program, focuses on strengthening the team, engaging the community, and sustaining palliative care. Once secondary hub locations are implemented, these goals could form their operational philosophy in order to ensure appropriate care is delivered, need is responded to, and programs are sustained.

Overall, the results of this study are likely to be useful for allocating palliative care resources in rural and remote BC, Canada. It is apparent that residents in rural and remote areas in the province have relatively poor existing access to SPC services. Bridging the identified gaps in service provision is perhaps more probable now that there is increased awareness that persons living in rural and remote areas have limited access to quality multidisciplinary care whether on site or at home (Wilson *et al.*, 2006). Centralized secondary hub locations, situated so as to maximize spatial accessibility in conjunction with existing primary hubs, are a potential solution to improving access to palliative care for those in need. These hubs are poised to help eliminate the four key challenges to providing quality palliative care as outlined above. Implementation of secondary hubs networked with primary hubs could: ensure that all locations have similar quality and availability of services, reduce the lack of understanding by practitioners and caregivers regarding referral procedures, provide information and counselling so patients and loved ones are willing to accept a terminal prognosis, and promote palliative care for all terminally ill patients. In addition, the set of methods described in this study could readily be applied to other health or social service facility siting problems in rural BC, or translated to another jurisdiction with similar topographic characteristics.

3.5.2 Limitations

It is possible that the model of suitability may not capture all the elements that indicate appropriateness for siting palliative care services in rural and remote communities. Future research is planned that will examine other factors indicative of site suitability. Interviews with key informants (i.e., formal and informal palliative care providers, health service administrators) in a potential hub site (Castlegar) and three communities in its catchment (Trail, Nelson, and Rossland) are being undertaken which may produce new factors that could be measured to indicate site suitability. In particular, it is expected that these interviews will shed light on a greater spectrum of demographic and socio-economic indicators of vulnerability which may determine palliative care need in each community. The interviews may also uncover information on other determinants of need in the communities, such as the local level of engagement on end-of-life care issues, the existence of support networks, political orientation, and the incidence of terminal disease. Any new information could potentially be added to the siting model to improve decision-making for palliative care resource allocation. The absence of an economic analysis may be another potential limitation to this study. A cost-benefit analysis may also be required to allocate resources, given current restrictions on health care spending. For example, implementation of secondary PCHs in some communities may be more cost-effective than in others. Assigning an equal importance weight to each of the three factors in the model may be subject to certain limitations, as it could be argued that one of the factors is more important than the others in determining palliative care service need. To examine this possibility, sensitivity analyses were conducted in which a higher importance weighting was rotated between each of the three factors. Results were largely inconsequential. The three most suitable communities highlighted in

the original equally-weighted scenario were also found in all three weighting scenarios. No community in any of the scenarios changed more than 2 positions up or down between the different weighted rankings. It was decided to retain the equal-weight scenario because little evidence could be found to indicate a greater importance of one factor for determining the optimal location for palliative care services, and as a result of the large degree of concurrence between all of the factor-importance weighting scenarios.

3.6 Conclusions

Despite palliative care growing in importance over the past decades, high quality, appropriate care is still not available to all who could benefit from it. Gaps in care delivery have been acknowledged by health organizations, which are beginning to address the issue with new frameworks on end-of-life care. Barriers to the delivery of optimal and appropriate care are well known. Residents of rural and remote regions face increased barriers to accessing these services, including fewer service providers, transportation problems, geographic isolation, and a lack of service availability. This paper has introduced a location analysis model to determine appropriate locations for secondary PCHs to provide palliative care to local rural and remote regions in BC.

Nineteen communities currently without spatial access to SPC were scored and ranked based on three fundamental factors that indicate site suitability: population, isolation, and vulnerability. The results of the model reveal that communities in the Interior Health Authority and Northern Health Authority have the greatest need for the local development of palliative care, and are the most appropriate locations for new regional secondary hub locations. Castlegar and Nelson, two closely situated communities in the Interior Health Authority, are the most appropriate communities

overall. Other communities in the same Authority which may be appropriate secondary PCH hosts are Cranbrook, Fernie, and Kimberley. In the Northern Health Authority, Kitimat and Fort St. John are the most suitable locations.

Regional secondary PCHs in rural and remote BC should be implemented in one or more of the recommended communities to address the commitment by the BC Ministry of Health for quality palliative care to be available as close as possible to the home location of the recipient. A centralized hub should be developed using a holistic approach that includes the provision of palliative medicine, education of local physicians and caregivers, social care and support through the integration of spiritual leaders and patient advocates into care teams, and the creation of standards for non-hospital-based care. These hubs should be implemented using careful strategic planning using a model of program implementation, such as the rural palliative care model described by Kelley (2007).

The results of this study are valuable for allocating palliative care resources in rural and remote areas and their management so as to ensure the maximum number of people will benefit from such care. Additionally, the set of methods described and tested in this study could be used to allocate resources for other health or social care services in Canada or other regions with similar rural and remote areas.

CHAPTER 4

CONCLUSIONS

This thesis has succeeded in exposing important issues regarding the delivery of palliative care in British Columbia (BC). Findings suggest that current service provision is inequitable, particularly for people who reside farther away from the large urban centres of the province. This main discovery runs counter to the principles of accessibility and universality that are cornerstones of the Canada Health Act, and is divergent from recent Canadian health policy that has committed to providing broad-ranging appropriate palliative care for all residents who may need it.

The first objective of this thesis was to determine the areas of the province in which residents have unfavourable access to broad-ranging and multidisciplinary specialized palliative care. As little cohesive information existed regarding the level of palliative services available in the communities of BC, the presence of a hospice residence or hospital with a specialized palliative care unit were used as proxy measures for availability of multidisciplinary palliative care in a community. In Chapter 2, GIS-based spatial accessibility techniques were used to determine catchment service areas for all 32 current and future sites of multidisciplinary palliative care in BC, and the proportion of the population of each Health Authority within a one-hour drive to a service location was calculated. This step also illuminated that 50 of 93 Urban Area communities in BC are situated more than one-hour away from a care location.

Upon examination of the spatial distribution and resulting accessibility of palliative care in BC, the analysis in Chapter 3 sought to assess the potential suitability of communities that were un-served according to our model, as new host communities where on-the-ground palliative care could be enhanced. The concept of the palliative care hub was developed, and proposed as a novel way for multidisciplinary care to be delivered to those people who reside in the rural and remote regions of the province. Research on community suitability for palliative care led to the development of a location analysis model. The objective functions guiding this model were typical of many health service accessibility efforts; maximizing the number of people in un-served regions who could potentially access this service, and reducing the travel-time associated with service access for residents of these areas. Based on the best available knowledge, the model was created to examine three important factors that may indicate how appropriate a community is for secondary palliative care hub implementation.

The first factor that was examined was the total population likely to utilize the services; that is, the number of residents living within a one-hour drive to the community. The second factor was isolation, calculated as the travel-time from the community to a current primary hub location. Vulnerability was the third factor examined, assessed as the number of residents 65 and older in the catchment area. The communities received a score based on the combination of these three factors, and were ranked for overall suitability as a new secondary hub. The results of the suitability model illuminated the most appropriate communities for secondary hubs; the vast majority of the most suitable locations were in the Kootenay region of the Interior Health Authority (IHA). Although less suitable overall than the examined communities in the IHA, several locations in the

Northern Health Authority (NHA) should also be considered as new hub sites. The circumstances of the NHA must be taken into account: this is a region with a very small population dispersed over a very large area.

Overall, implementation of a secondary hub in either Nelson or Castlegar in the West Kootenays, Cranbrook in the East Kootenays, Kitimat in the northwest of the province, and Fort St. John in the northeast would improve access to diverse multidisciplinary palliative care for many people who reside away from the province's major centres. This could represent a major step towards providing equitable access for all, which is set to become even more important as palliative care is thrust further into the mainstream of health care.

4.1 Research Contributions

This thesis represents the first comprehensive analysis of the spatial accessibility of palliative care in BC, and is one of a very small number in existence worldwide. Increasing interest in palliative care provided the stimulus for this research to be conducted, and recently developed GIS-based spatial accessibility methods appropriate for large region analyses have allowed this research to be undertaken. The findings provide strong decision support for the BC Ministry of Health to expand access to these important services.

Explication of the palliative care hub service delivery concept is a major contribution of this thesis. Rural and remote areas should not be overlooked because their population base is too small and dispersed to support infrastructure and a multidisciplinary team of specialists. A key feature of the hub concept is that they can be

tailored to fit a local situation. Secondary hubs could operate out of existing infrastructure such as a hospital or residential care facility. Alternatively, a physical site is not necessary as care can also be delivered in the patient's home. Whether or not secondary hubs include physical infrastructure, such as residential beds, the coordination of appropriate care to a high standard in the local region, and the strong links with specialists in primary hubs may be the most important aspects of this service delivery concept.

Beyond the implications of this thesis for health policy, demonstration of the techniques is also of value. The set of methods developed and applied in this thesis may be useful for other purposes. The spatial accessibility techniques could be utilized to examine access to other health and social services in BC, or indeed any other large region with similar population and geographic characteristics. The location analysis model could also be translated for facility siting or service allocation for other health service types. Any appropriate variable or combination of variables could be used to examine vulnerability of a community for a specific health service, depending on the indicators specific to that health care type.

4.2 Future Work

Although the results of this thesis could readily contribute to addressing the problem of inadequately accessible palliative care services, the findings also represent a jumping off point for future research. Future studies may wish to build on this study by examining other aspects that determine suitability for palliative care in a community. Barnes (2003) argues that location analysis should look beyond numbers and equations, and should endeavour to examine local characteristics and variability in greater detail

when selecting sites or allocating resources. This notion is in line with the push for greater emphasis put on place in health geography's recent renaissance. While the model presented in this study did examine characteristics of local communities, a future study may wish to integrate local determinants of site suitability into the equation. A qualitative approach may be best suited to uncovering local variability and community-specific factors. Integration of this perspective with the current methods in a mixed-method location analysis model is likely to provide even more robust findings. This is the focus of future research that will be undertaken in various regional communities in BC.

Concurrent to this study, qualitative research was conducted with the aim of uncovering unique characteristics of palliative care in rural locations. Interviews with palliative care stakeholders in the communities of Nelson, Castlegar, and Rossland provided a wealth of local information, including current palliative care capacity, drive to increase services in the local area, and level of support for future service expansion. Plans are underway to include these elements into the site suitability model developed in this thesis. The results of this mixed-method location analysis study are likely to provide even greater insight into the potential of the unserved communities to host a secondary palliative care hub, by also assessing qualitative, local-specific site suitability factors.

In relation to the future applications discussed above, it is worth noting that the results of this study present a heuristic algorithm for assessing site suitability based on available knowledge which may or may not provide the optimal solution for improving palliative care accessibility. The principal intention of this study was to provide a pragmatic option for improving access to palliative care services, specifically aimed at residents of rural and remote regions. This thesis has achieved that goal; however, future

work may seek to optimize access to services for the province as a whole. Although these two goals are closely related, results of a study of the latter may find that different locations are more appropriate for palliative care resource allocation, in which the goal is maximizing the number of people with access, irrespective of rural/urban habitation. For example, adding services in an urban area of the Vancouver Coastal Health Authority may improve access for a greater number of residents of BC because of the greater density of people, without improving access for rural and remote residents.

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