Assessing the suitability of host communities for secondary palliative care hubs: A location analysis model

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A R T I C L E I N F O

Article history:
Received 30 July 2008
Received in revised form 13 January 2009
Accepted 22 January 2009

Keywords:
Palliative care
Health service delivery
Rural and remote
Canada
GIS

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.

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Introduction

A strong commitment to palliative care has emerged in the few decades since its modern inception (Saunders, 2000; Meghani, 2004). As populations age, the provision of appropriate care for terminally ill individuals, their carers and their families has become a priority (Pease and 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 and Beaudoin, 2000; Romanow, 2002b; Carstairs, 2005). A shortage of available services (e.g., support for in-home care, hospice residences, and 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 (Van Den Elzen, 2006; Réseau de soins palliatifs du Quebec, 2007). 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 and Schuurman, 2008).

The major barriers to the effective provision of optimal and appropriate palliative care are well documented (Bestall et al., 2004; Van Vorst et al., 2006; Dudgeon et al., 2007). 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 (Van Vorst et al., 2006; Virnig et al., 2006; Kortes-Miller et al., 2007). Many challenges exist in
delivering health and social care in these regions which stem from the two fundamental, inter-related 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 and 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.” 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 healthcare 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 (Lomas et al., 1997; Frankish et al., 2002; 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 geographic information system (GIS)-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 and Skelly, 2002; McGregor et al., 2005; Schuurman et al., 2006).

**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 multiprofessional 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 and 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 and Higginson, 1998). A study of the factors that affect the place of death (McNamara and 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 and 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, and 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 (Gilbar and Steiner, 1996; Higginson and Sen-Gupta, 2000; Brazil et al., 2005; Government of British Columbia, 2006; Canadian Institute for Health Information, 2007; Howat et al., 2007; McNamara and Rosenwax, 2007). In addition, a secondary PCH could co-ordinate home care to ensure that consistent and appropriate care is delivered in the patient’s home. Wilkses 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 co-operation 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 co-ordinated 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.
A model to determine a community's palliative care need

Health resource allocation decisions are complex and multifaceted (Fraser and 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 (Mitton and Donaldson, 2002; McLafferty, 2003). 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 and 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 Fig. 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 unserviced 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 (Hanlon and Halseth, 2005; Cloutier-Fisher and Skinner, 2006). 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 and 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 and 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 and 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 and 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.

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/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 1 h travel-time catchment area. Communities with a larger population in their catchment were considered to have greater need for palliative care services. One hour\(^1\) 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 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 0–1 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.

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\(^{1}\) 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 1 h time window for travel has been confirmed as sound. The biggest driver for the use of 1 h 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.

\(^{2}\) 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.
(5065), low number of vulnerable residents (145), and relative lack of isolation (2.2 h 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 (1640), and its location just 1.7 h from a primary PCH location.

**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 one-hour from existing primary PCH catchments. 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. Fig. 2 reveals that the majority of the most suitable communities are located in the south-east 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

### Table 1

Factors indicating the suitability of a community for a secondary palliative care hub.

<table>
<thead>
<tr>
<th>Community</th>
<th>Health authority</th>
<th>Population Catchment total pop.</th>
<th>Nearest primary PCH</th>
<th>Travel-time (h)</th>
<th>65+Population (total)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Campbell River</td>
<td>Vancouver Island</td>
<td>90,301</td>
<td>Qualicum Beach</td>
<td>1.3</td>
<td>13,370</td>
</tr>
<tr>
<td>Castlegar</td>
<td>Interior</td>
<td>56,982</td>
<td>Penticton</td>
<td>3.5</td>
<td>10,145</td>
</tr>
<tr>
<td>Cranbrook</td>
<td>Interior</td>
<td>40,410</td>
<td>Penticton</td>
<td>6.0</td>
<td>5990</td>
</tr>
<tr>
<td>Dawson Creek</td>
<td>Northern</td>
<td>38,741</td>
<td>Prince George</td>
<td>4.5</td>
<td>3610</td>
</tr>
<tr>
<td>Fernie</td>
<td>Interior</td>
<td>33,815</td>
<td>Penticton</td>
<td>7.1</td>
<td>4495</td>
</tr>
<tr>
<td>Fort St. John</td>
<td>Northern</td>
<td>42,449</td>
<td>Prince George</td>
<td>4.9</td>
<td>3875</td>
</tr>
<tr>
<td>Gibsons</td>
<td>Vancouver Coastal</td>
<td>25,624</td>
<td>N. Vancouver</td>
<td>1.5</td>
<td>5340</td>
</tr>
<tr>
<td>Kimberley</td>
<td>Interior</td>
<td>34,131</td>
<td>Vernon</td>
<td>6.3</td>
<td>5125</td>
</tr>
<tr>
<td>Kootenay</td>
<td>Northern</td>
<td>29,987</td>
<td>Prince George</td>
<td>7.3</td>
<td>2450</td>
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<td>Mackenzie</td>
<td>Northern</td>
<td>50,651</td>
<td>Prince George</td>
<td>2.2</td>
<td>145</td>
</tr>
<tr>
<td>Nelson</td>
<td>Interior</td>
<td>53,786</td>
<td>Penticton</td>
<td>4.1</td>
<td>9105</td>
</tr>
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<td>Powell River</td>
<td>Vancouver Coastal</td>
<td>19,109</td>
<td>Qualicum Beach</td>
<td>2.7</td>
<td>3165</td>
</tr>
<tr>
<td>Prince Rupert</td>
<td>Northern</td>
<td>15,485</td>
<td>Prince George</td>
<td>8.4</td>
<td>1275</td>
</tr>
<tr>
<td>Revelstoke</td>
<td>Interior</td>
<td>15,810</td>
<td>Vernon</td>
<td>1.9</td>
<td>3355</td>
</tr>
<tr>
<td>Smithers</td>
<td>Northern</td>
<td>18,995</td>
<td>Prince George</td>
<td>4.4</td>
<td>1595</td>
</tr>
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<td>Terrace</td>
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<td>20,420</td>
<td>Prince George</td>
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<td>1645</td>
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<tr>
<td>Trail</td>
<td>Interior</td>
<td>50,784</td>
<td>Penticton</td>
<td>3.8</td>
<td>8595</td>
</tr>
<tr>
<td>Whistler</td>
<td>Vancouver Coastal</td>
<td>27,550</td>
<td>N. Vancouver</td>
<td>1.7</td>
<td>1640</td>
</tr>
<tr>
<td>Williams Lake</td>
<td>Interior</td>
<td>26,476</td>
<td>Quesnel</td>
<td>1.4</td>
<td>3085</td>
</tr>
</tbody>
</table>

**Fig. 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.
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.

The largest cities and regional centres in BC are mostly well-served for SPC by existing primary hubs (Cinnamon et al., 2008). However, the communities which are situated in rural or remote regions are poorly served. Results of this study indicate that the largest, most centrally located of these communities should be designated as secondary PCHs, with the most appropriate examples being either Castlegar or Nelson in the IHA and Kitimat or Fort St. John in the NHA.

### 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. Care delivered in this way could be implemented and managed at the local PCH. Furthermore, insufficient support, manifest in poor co-ordination 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

### Table 2

<table>
<thead>
<tr>
<th>Community</th>
<th>Health authority</th>
<th>Population score</th>
<th>Isolation score</th>
<th>Vulnerability score</th>
<th>Overall score</th>
<th>Overall rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Campbell River</td>
<td>Vancouver Island</td>
<td>1.000</td>
<td>0.154</td>
<td>1.000</td>
<td>2.154</td>
<td>1</td>
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<tr>
<td>Castlegar</td>
<td>Interior</td>
<td>0.631</td>
<td>0.420</td>
<td>0.759</td>
<td>1.810</td>
<td>2</td>
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<tr>
<td>Nelson</td>
<td>Interior</td>
<td>0.596</td>
<td>0.490</td>
<td>0.681</td>
<td>1.767</td>
<td>3</td>
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<tr>
<td>Trail</td>
<td>Interior</td>
<td>0.562</td>
<td>0.449</td>
<td>0.643</td>
<td>1.655</td>
<td>4</td>
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<td>Cranbrook</td>
<td>Interior</td>
<td>0.448</td>
<td>0.716</td>
<td>0.448</td>
<td>1.611</td>
<td>5</td>
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<td>Fernie</td>
<td>Interior</td>
<td>0.374</td>
<td>0.843</td>
<td>0.336</td>
<td>1.554</td>
<td>6</td>
</tr>
<tr>
<td>Kimberley</td>
<td>Interior</td>
<td>0.378</td>
<td>0.747</td>
<td>0.383</td>
<td>1.508</td>
<td>7</td>
</tr>
<tr>
<td>Kitimat</td>
<td>Northern</td>
<td>0.332</td>
<td>0.874</td>
<td>0.183</td>
<td>1.390</td>
<td>8</td>
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<tr>
<td>Fort St. John</td>
<td>Northern</td>
<td>0.470</td>
<td>0.585</td>
<td>0.290</td>
<td>1.345</td>
<td>9</td>
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<td>Prince Rupert</td>
<td>Northern</td>
<td>0.171</td>
<td>1.000</td>
<td>0.095</td>
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<td>10</td>
</tr>
<tr>
<td>Dawson Creek</td>
<td>Northern</td>
<td>0.429</td>
<td>0.536</td>
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<td>1.235</td>
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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; Kortes-Miller et al., 2007; Stjernsward 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 counseling 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.

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.

Conclusion

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.

Acknowledgements

Funding for this research was provided by the British Columbia Medical Services Foundation and British Columbia Rural and Remote Health Research Network. NS is funded by a Michael Smith Foundation for Health Research Scholar Award and a Canadian Institutes of Health Research New Investigator Award.

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