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Refining a Location Analysis Model Using a Mixed Methods Approach: Community Readiness as a Key Factor in Siting Rural Palliative Care Services

Valorie A. Crooks¹, Nadine Schuurman¹, Jonathan Cinnamon¹, Heather Castleden², and Rory Johnston¹

Abstract
Drawing on recent debates pointing to the value of mixed methods research in human geography, the authors revisit a quantitative location analysis model previously created to site palliative care services in rural British Columbia, Canada. The original quantitative model posited that population (i.e., number of residents in the community), isolation (i.e., travel time to existing specialized palliative care), and vulnerability (i.e., number of residents older than 65 years in the community) are three factors that must be accounted for when siting palliative care services in rural areas. Using qualitative interview data, the authors refine this model to include a newly identified factor: community readiness. They conclude with a discussion of the benefits of adopting a mixed methods approach to location analysis model development.

Keywords
mixed methods, location analysis, palliative care, health services, rural

As the populations of many developed countries continue to age at rapid rates, the provision of care for people at the end stages of life is emerging as a mainstream public health issue. More specifically, increasing demand for services targeted at this stage of the life course, frequently referred to as palliative care, and desires to ensure that the best quality and most compassionate care possible is being given are bringing increasing attention to this public health and, subsequently health services, issue (British Columbia Hospice Palliative Care Association, 2005; Connor, 2007; Krakauer, 2008; Kuebler, Lynn, & Von Rohen, 2005). The need to enhance palliative care provisioning in Canada is gaining increasing attention, where it is predicted that one in five

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Canadians will be 65 years or older by 2026, up from one in eight in 2001 (Government of Canada, 2002). This dramatic rise in the number of older people will inevitably produce greater demand for palliative care services. Reports by government and palliative care organizations in Canada have described a current scarcity of services and are forecasting a widening gap between demand and service availability in the coming years (e.g., British Columbia Hospice Palliative Care Association, 2005; Carstairs, 2005; Romanow, 2002). Furthermore, increasing recognition of the benefits of receiving palliative care at the end of life is providing momentum for achieving greater integration of such care—which is a relatively new discipline when compared to other forms of medical care—into modern health care systems (Dudgeon et al., 2008; Government of British Columbia, 2006; Higginson et al., 2003). Despite recent attention regarding the need to increase the availability of palliative services for Canadians, little attention has been given to the problem of rural/urban variation in service availability (Crooks & Schuurman, 2008).

Rural Canada is vast and characterized by small and scattered populations and significant distances between communities (Goertzen, 2005). As a result of these geographic and demographic realities, there are added challenges that exist in providing palliative care outside of Canada’s few metropolises. Despite the presence of publicly funded “universal health care” throughout the country that aims to eliminate cost as being a barrier to care, many palliative therapies and medications remain unavailable in rural settings because the benchmark of care that are required to administer them—a multidisciplinary team of palliative practitioners and specialists—is typically unavailable in such communities (Robinson et al., 2009). At the same time, Canadians continue to die in rural areas. For example, in the province of British Columbia (BC) almost one third of deaths occurring in the two geographically largest regional health authorities—as opposed to most populated—happen in rural areas (Canadian Institute for Health Information, 2008). Residents of these rural areas, along with their informal family caregivers, are likely to be vulnerable to negative impacts on health and well-being at the end of life if appropriate services are unavailable to them in local settings. Efforts should thus be made to increase availability of the full spectrum of palliative services in rural areas in a manner that maximizes existing resources and potential use.

It is apparent that innovative models of service delivery are needed to improve the availability of quality palliative care in rural areas (Robinson et al., 2009). The secondary palliative care hub (SPCH) is a novel service siting model introduced in a study by Cinnamon, Schuurman, and Crooks (2009) as a practical solution for enhancing the availability and variety of palliative care services for residents of rural and remote regions of BC. SPCHs are carefully selected rural communities deemed to be most suitable for enhancing their palliative care service delivery. They are envisioned as communities that do not presently support a residential hospice or other specialized palliative services but are linked with those services and their providers at primary palliative care hubs located in larger, more urban centers (Cinnamon et al., 2009; Crooks, Castleden, Schuurman, & Hanlon, 2009). It is anticipated that a rural community’s designation as an SPCH and the subsequent practice initiatives undertaken as a result could increase access to specialist palliative practitioners, medications, and therapies and create opportunities for bidirectional information exchange and educational opportunities through advancements such as telemedicine and videoconferencing (Crooks et al., 2009). This way, SPCHs can ensure that patients in rural and remote areas of BC are receiving services that are appropriate to their needs and not simply based on what happens to be currently available in the local region. In addition, enhancement of palliative care services in communities deemed suitable as SPCHs may assist with working toward ensuring that palliative home care in the catchment area is delivered according to commonly accepted standards, such as the gold standards set out by the Canadian Hospice Palliative Care Association (2006). The overall vision of the SPCH siting model is aimed at harmonizing the imbalance in service accessibility between urban and rural Canada.
The purpose of the present article is to revise a location analysis model previously created for siting SPCHs using quantitative data by drawing on the findings of a qualitative study involving interviews with formal and informal palliative care providers in a rural region of BC’s interior. More specifically, and as we show in greater detail later on in the article, the interviews reveal that a new “arm” must be added to the model: that of community readiness. Using the findings of the qualitative data, we identify five specific indicators of community readiness, and combine these with the original features of the quantitative model (population size, isolation, and vulnerability) to create a revised location analysis model. The overall objective is to present a robust mixed methods location analysis model that can be used to objectively site SPCHs in the most suitable and ready communities in BC. In meeting this objective, and through undertaking the analysis outlined above, we also address calls to take on the challenge of engaging in mixed methods, or even “hybrid” (Kwan, 2004), geographic research. As Kwan (2004) observes, those geographers who have taken on this challenge “often use mixed methods to explore the multiple realities and stories constituted through the complex interactions between knowledge, powers, and social and political change” (p. 758). In doing so, mixed methods approaches can assist with overcoming the quantitative–qualitative methodological divide while also bridging seemingly dissimilar areas of the discipline. We do just this in the present article through using qualitative health geography to inform the development of a quantitative model using geographic information systems (GIS), which is focused on palliative care services.

Mixed Methods Research in Human Geography

Tashakkori and Teddlie (2003) argue that a methodologically driven movement is slowly taking place within the social sciences: the use of mixed methods approaches to address research questions. They term this the third methodological movement as it has been taken up following the quantitative (the first) and qualitative (the second) movements. Cresswell (2009) confirms this trend, noting that mixed methods study designs are becoming increasingly popular. Studies can benefit from employing a mixed methods approach to understand complex research problems better and specifically to enhance confirmation and comprehension via the employment of multiple methods of data collection and/or analysis (Dunning, Williams, Abonyi, & Crooks, 2008; Tashakkori & Teddlie, 2003). Here we consider mixed methods studies to be those that integrate qualitative and quantitative methods of data collection and/or analysis, as opposed to multimethod studies that employ multiple quantitative or multiple qualitative methods. Proponents of mixed methods research praise the enhanced ability to answer new questions and gain better insight into the particularities of a research problem than can be offered by solely remaining within one paradigm (Cresswell, 2009; Leech & Onwuegbuzie, 2007). In particular, as Sale, Lohfeld, and Brazil (2002) have expressed, mixing methods in a research study is especially useful for the purposes of complementarity: using the strengths of one method to enhance or complement the other.

Within the discipline of human geography, researchers with a variety of interests subscribe to an expanding variety of methodologies and the philosophies that underpin them. As such, there is a range of data collection methods and analytic techniques employed within the discipline. Over the past decade, and following the third methodological movement within the social sciences at large, there have been increasing calls for geographers to engage in mixed methods research. In 1995, Lawson called for the putting aside of the quantitative–qualitative dualism within the discipline so as to recognize the usefulness of quantitative approaches in social research. Her piece was part of a special collection in The Professional Geographer that offered some early, open discussion of the advantages of using mixed methods and quantitative approaches in feminist geography research. Madsen and Adriansen (2004), Rocheleau (1995),
and Yeung (2003) have all since contended that mixed methods research within geography yields findings that are richer than when either quantitative or qualitative methods are employed. McKendrick (1999) agrees and further suggests that the increasing types, amounts, and sources of data being made available to geographers warrants a broader range of methodological tools being used in geographic research. Such calls make it clear that there are advantages to be had from employing mixed methods designs in geographic research.

Although there are many areas within the discipline of geography where mixed methods approaches are of interest, one gaining increasing amounts of attention pertains to the mixing of quantitative and qualitative data sets in GIS-based spatial analyses (Kwan & Knigge, 2006; Townley, Kloos, & Wright, 2009; Wang, Rosenberg, & Lo, 2008). Kwan (2004) has suggested that, rather than trying to reconcile differences between the various camps within the discipline, geographers should celebrate their differences and promote “hybrid geographies,” which includes the incorporation of qualitative data into GIS. A principal criticism of GIS has been its apparent entrenchment within the quantitative positivist paradigm (see Knigge & Cope, 2006; Kwan, 2002; Schuurman, 2000). Despite the obvious union of GIS and the quantitative worldview, recent research has shown that there is room for qualitative data and methods to be used to inform GIS-based spatial analyses. For example, Skinner, Matthews, and Burton (2005) combined ethnographic data with GIS representation techniques to examine service accessibility and child well-being. Also, Maroko, Maantay, Sohler, Grady, and Arno (2009) used quantitative and qualitative approaches together in a spatial analysis of access to parks and physical activity sites in New York City. As demonstrated in these and other studies, the combination of traditional quantitative spatial analysis techniques with case studies consisting of fieldwork and archival research has helped to reveal trends in accessibility that may have been overlooked otherwise. These examples are just a small part of a growing number of studies that are effectively integrating GIS into mixed methods study designs. We situate the analysis reported on herein within this particular area of mixed methods interest in the discipline, which has seen little consideration of the application of such research design to issues of health services, let alone palliative care specifically.

**Previous Work**

The analysis presented herein contributes to a larger study designed to determine those communities in rural and remote BC that are most suitable to host SPCHs and also to refine the vision for how communities designated as hubs could potentially enhance their palliative care services. First, an analysis was conducted to determine the spatial accessibility of existing specialized palliative care in BC (Cinnamon et al., 2008). The purpose of this analysis was to identify the regions and communities that were not considered to have spatial access to specialized palliative care. A 1-hour travel time was set as the measure of spatial accessibility, whereby communities situated more than 1 hour from a community with specialized palliative care were considered unserved. A location analysis model was then developed, following the work of Schuurman, Bell, Hameed, and Simons (2008), to assess the suitability of these unserved rural BC communities to be designated as secondary hub communities by examining three quantitative indicators of suitability (Cinnamon et al., 2009). The factors that were included in the model were the following: the total population within an hour of the community (where larger populations are more suitable), the vulnerability of the community calculated as the total population 65 years and older in the 1-hour area (where larger such populations are more suitable), and the isolation of the community as measured by travel time to the nearest specialized palliative care facility (where longer travel times to existing facilities are more suitable). The population of residents who are 65 years and older was counted in both the total population variable as well as the vulnerability...
variable to amplify the suitability of communities with relatively large numbers of residents in this age group for enhancing their palliative care services. Nineteen communities located in rural BC were assessed using GIS location analysis methods, most of which are located in the highly rural and remote Interior and Northern Health Authorities—administrative regional jurisdictions established throughout the province to organize and administer health services. Both these health authorities comprise vast, lowly populated regions in which the delivery of health services in an equitable and accessible manner—where ensuring equitable and accessible services is a core principle of Canada’s publicly funded health care system—is a constant challenge. The results of this analysis provided valuable information regarding the communities that are most appropriate for enhancement of palliative care services.

After the completion of the two analyses outlined briefly above, interviews \( (n = 31) \) were undertaken with formal and informal palliative care providers in a specific area of BC’s rural interior known as the West Kootenay-Boundary region. The instrumental case study methodology was used to guide this aspect of the study (Stake, 1995). The goal of the interviews was to examine palliative care service provision in a medically underserviced rural region of BC, as determined through the spatial analyses, to test responsiveness to the SPCH siting model and determine localized barriers and facilitators to existing palliative care service delivery. Three communities that were deemed most suitable in the region to serve as secondary hubs were selected for primary data collection: Castlegar, Nelson, and Trail. Phone interviews were undertaken with informal (e.g., family caregivers, pastors, volunteers) and formal (e.g., nurses, family doctors, administrators) palliative care providers working in these three communities. Table 1 summarizes the participants’ occupations. Of the 31 interviewees, 13 identified Castlegar to be their main community of practice, 11 identified Trail, and 5 identified Nelson. The remaining 2 were based in rural northern BC and were familiar with the state of rural palliative care provision throughout the province. Their responses were complementary to those offered by the respondents from the case study communities and so were integrated into the data set.

Phone interview participants were recruited using a purposeful strategy to maximize diversity in terms of occupation and practice location through a number of targeted recruitment efforts. Interviews lasted on average for 1.5 to 2 hours, and participants were asked about: community descriptions, community health and health care priorities and challenges, experience with palliative care provision, existing palliative care service availability and future need, and the SPCH approach. Interviews were transcribed verbatim and entered into NVivo8™ for data management. Thematic analysis was employed, which involves categorizing coded data based on patterns evident within the data set and comparing these patterns with the study purpose and literature (Aronson, 1994). Investigator triangulation was used at all steps in the coding and interpretation processes to enhance the rigor of the analytic process (Whittemore, Chase, & Mandle, 2001). Five meta-themes were identified in the qualitative data set: (a) Aboriginal-focused palliative care, (b) the role of place in rural palliative care provision, (c) the politics of palliative care, (d) visioning for SPCHs, and (e) health service administration. Findings related to these themes have been written up and presented elsewhere.

In the case of the present analysis, when the qualitative findings across the five meta-themes were compared against the initial spatial analyses, it became clear that an additional factor needed to be added to the siting model: community readiness. Following this realization, specific variables that collectively inform community readiness were identified in the data set (i.e., those that indicate a community’s readiness to enhance its palliative care services). Next, coding extracts were carefully reviewed by two investigators to identify congruence across participants and participant groups regarding their relative importance. The five identified community readiness variables and verbatim quotations supporting their inclusion were then presented to the entire investigative team to confirm interpretation of the data and collectively identify specific
indicators that could be gathered to enable assessment of the presence or absence of each in the communities of focus.

**Data and Methods**

This mixed methods analysis combines the data used in the original spatial analyses reported on in Cinnamon, Schuurman, and Crooks (2008; Cinnamon et al., 2009) and the qualitative interview data mentioned above. As a reminder, the earlier model designed to determine those communities that do not have specialized on-site palliative care most in need of enhancing palliative care provision incorporated three distinct variables: (a) population, (b) isolation, and (c) vulnerability. The three variables were standardized to a common scale of 0 to 1, with higher values indicating greater suitability. Scale transformation was performed using the maximum score procedure (Malczewski, 1999), in which the highest value becomes 1, and all other values fall between 0 and 1 while retaining the proportional variation between values. The newly gathered qualitative data set points to the inclusion of community readiness in the model. In this section, we first introduce the specific qualitative community readiness variables that were discussed by the participants and then move to identify their specific binary indicators for utilization in the siting model. Where possible, quotations are used verbatim to illustrate issues relevant to the variables. Those that best and most clearly illustrate the relevant issues have been selected for inclusion in this section, which is in keeping with procedures for qualitative data interpretation and reporting (Denzin & Lincoln, 2005).

**Community Readiness Variables: Qualitative Data Set**

It was not originally anticipated that findings of the qualitative interviews would warrant revisiting the siting model created previously for the earlier spatial analyses. However, it became clear that community readiness, a key factor with high relevance for siting SPCHs in needy communities and likely any other kind of palliative care service or infrastructure, had been neglected by the earlier model that focused more on demand and utilization factors. The qualitative data set revealed five community readiness variables: (a) community awareness, (b) training and education, (c) telemedicine utilization, (d) presence of family doctors, and (e) community momentum. In the remainder of this subsection, we describe these variables in greater details along with their importance as per the participants’ viewpoints.

Community awareness was found to be a necessary component when considering a community’s readiness for supporting further palliative care infrastructure. Participants indicated that the general public is typically not aware of what palliative care providers have to offer clients and

<table>
<thead>
<tr>
<th>Role/Occupational Group</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nursing</td>
<td>7</td>
</tr>
<tr>
<td>Health care administrator</td>
<td>6</td>
</tr>
<tr>
<td>Hospice/palliative care volunteer</td>
<td>5</td>
</tr>
<tr>
<td>Other</td>
<td>4</td>
</tr>
<tr>
<td>Family doctor</td>
<td>2</td>
</tr>
<tr>
<td>Pastor/minister</td>
<td>2</td>
</tr>
<tr>
<td>Hospice society worker</td>
<td>2</td>
</tr>
<tr>
<td>Allied health care professional</td>
<td>2</td>
</tr>
<tr>
<td>Family caregiver</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 1. Participants’ Occupations

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their families. It was suggested that this may be because of, at least in part, death and care at the end of life being somewhat taboo topics of discussion. Thus, it was not a part of daily discourse. “Palliative care is a pretty big word, but most people don’t understand until you explain... We’re doing all we can to promote the understanding of palliative care and the need is here, definitely.” Furthermore, although there may be a handful of palliative care champions in a community or region, it was explained that if palliative care does not have a profile in a community, then it typically does not receive attention, particularly in terms of funding and human resources. As one participant indicated, “There are few of us who have done what we can in terms of political voice, but [palliative care] does not share the same profile as birth issues.” In each of the three case study communities, local hospice societies operated to not only provide palliative care but also promote community awareness of palliative care services in the community and region. The role of these organizations in raising the profile, and thus awareness, of palliative care in the communities was seen as invaluable.

Training and educational opportunities were seen by participants as critical to not only creating awareness but also strengthening capacity in rural and remote communities throughout the region. Participants were asked whether or not they would be willing to travel in order to receive training. Indeed, many were willing to pay out of pocket for such expenses. “People here... are willing to go to conferences, to educational things, and cough it up themselves... People are definitely very willing to learn new things.” Although most were willing to travel and share costs, others proposed that it would be more cost-effective for out-of-area trainers to come to their region in order to build local capacity. It was noted that doing so could also enhance links with larger urban centers, whereby people based in those settings could potentially attend trainings and workshops held in smaller communities. Participants also recognized that highly qualified personnel that already existed in their region, which included those who were either in the field of palliative care or at the local community college holding teaching positions in the health/allied health care professions. It was suggested that such individuals could be further drawn on to create more localized training opportunities.

Participants suggested that to bridge physical distances between experts from other centers and local providers, telemedicine utilization would be an effective approach to enhancing local palliative care provision. It was frequently noted in passing that many of the communities in the region regularly make use of telemedicine for various interventions, screening, and consultation. “We have all kinds of telehealth happening; why can’t you have an expert in palliative care helping the locals with the situation?” However, in terms of community readiness, one participant issued the following caution: “Telehealth is wonderful, let’s utilize it. You know, but we need to make it available in each community. It’s not going to do any good if [one community] doesn’t have that.” From this it can be understood that equal access to resources such as telemedicine in local communities is, thus, key to regional palliative care success.

Family doctors play a vital role in providing palliative care in rural areas; they tend to provide care over the life course, thus gaining an intimate knowledge and understanding of a particular individual’s way of life and ultimately approach to death as well. Although there has traditionally been great difficulty in attracting family doctors and specialists to rural and remote areas in Canada, it was interesting to note that participants reported a growing trend among family doctors to move to the region as a “lifestyle choice.” As such, participants did not see doctor shortages as an issue; rather, they expressed concern that doctors continue to be trained in “curative” techniques rather than the more supportive ones (e.g., pain management) required for palliative care. “The hospital caregivers are excellent, but it’s curative, that’s the way they’re trained and palliative care’s a whole different... philosophy.” Thus, they supported the current situation in their region, wherein two family doctors reputed to have interests and expertise in palliative care could be turned to for professional advice by their peers.
Participants expressed serious concern about shrinking support and political inertia for palliative care in their region. They don’t prioritize palliative care at all . . . . I think that I’ve kind of seen the evolution of palliative care in the last ten years, and we started out with a fairly robust palliative care program when I arrived here [that has diminished since then].

Although political will and the public at large were not necessarily perceived to have demonstrated a desire for increased palliative care capacity, without question participants from across communities and professions were clear about their desires for this to happen. “I’m totally convinced that [having a] hospice house is the best damned thing that ever happened to palliative care.” Their passion for palliative care was palpable and their quest for a local residential hospice was ongoing. In fact, one of the local voluntary hospice societies had not only proposed a site for a residential hospice house but generated the funds necessary to purchase the structure. All that remained was the human resources funding necessary to operate it, but this had yet to be provided by the regional health authority. Participants made it clear that enhancing the visibility and availability of palliative care through further service delivery could act as the necessary momentum for ultimately implementing a local residential hospice house.

**Community Readiness Indicators: New Methods**

As can be seen in Table 2, indicators were identified to demonstrate the presence or absence of community readiness variables gleaned from the interviews. In many cases, any number of indicators could have been used to represent a variable either singly or in combination. However,
many indicators did not naturally lend themselves to quantification, which was necessary for inclusion in the SPCH siting model. Thus, quantitative data availability was a key parameter used to guide the identification of indicators by the investigative team. Indicators for each variable were ultimately compiled for each of the 19 communities assessed by the original model, and their data were subsequently added to the site suitability model. All indicators were measured as binary yes or no answers, yes answers received a .20 score, no answers received a 0 score. This scoring was used so that each “arm” (i.e., population, isolation, vulnerability, and community readiness) of the siting model was weighted equally, with a maximum score of 1 for each. Thus, the maximum score possible for the community readiness arm of the model was 1 if a community satisfied all five of indicators. Readiness scores were tabulated by adding the results of the readiness variables’ indicators together and combining this score with the previous suitability score in a mixed methods location analysis model.

The community awareness variable was considered to be a yes if a hospice society was in operation in the community, which was its indicator. This was determined by looking for hospice or palliative care societies in each of the communities using online search engines. For those communities that did not show positive results, the listings of the BC Hospice Palliative Care Association were further checked for local societies. The second variable, training and education, was measured by the presence of a college or university within the community that could serve as a site for training and workshops. This information was gathered from municipalities’ websites and was cross-referenced against more general Internet search engine findings using relevant terms. As educational institutions were located their websites were searched to see if additional campuses were located in other communities of focus. The telemedicine utilization variable was determined by contacting the local hospital to see if telemedicine was used regularly. Specifically, calls were placed to the administrative assistant or main nursing desk in order to obtain this information. Local hospice societies were contacted to determine whether discussions or proposals had been developed with the intention of creating a hospice residence in the community, which was done by calling the societies directly. If so, these communities were considered to have momentum for enhancing palliative care within the community.

The indicator for the variable presence of family doctors was determined by first calculating the number of family and general practitioners in the community, which is available in the MDSelect (2009) database. The family physician to population ratio was then calculated using Census of Canada 2006 figures (Statistics Canada, 2006). A benchmark of one family physician for 1,307 people was used following available recommendations (Federal/Provincial Advisory Committee on Health Manpower, 1984; Natural Resources Canada, 2004). Communities with family physician to population ratios at this level or better were considered to fulfill this readiness indicator.

Results

Table 3 combines the results of the community readiness indicators derived from analysis of the qualitative data set with the previously determined quantitative siting factors. It was found that community readiness for enhancing palliative care services varied greatly between the communities. Of the 19 potential communities, only 9 fulfilled all five of the community readiness indicator criteria: Campbell River, Castlegar, Nelson, Trail, Cranbrook, Fernie, Fort St. John, Dawson Creek, and Smithers. Four indicators were present in Kimberley, Kitimat, Williams Lake, and Revelstoke. Prince Rupert, Terrace, and Gibsons fulfilled three indicators, whereas Powell River and Whistler satisfied only two. Mackenzie was found to lack all of the community readiness requirements for a siting a SPCH locally. Viewed from another perspective, 16 communities each had a local hospice society (community awareness), a local university or college campus (training/education sites), and an adequate supply of
Table 3. Suitability Indicators, Readiness Indicators, and Overall Rank for Potential Secondary Palliative Care Hub Communities

<table>
<thead>
<tr>
<th>Community</th>
<th>Population Score</th>
<th>Isolation Score</th>
<th>Vulnerability Score</th>
<th>Total Suitability Sum</th>
<th>Community Awareness</th>
<th>Site for Training</th>
<th>Telemedicine Physicians</th>
<th>Momentum</th>
<th>Total Readiness Sum</th>
<th>Overall Score</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Campbell River</td>
<td>1.00</td>
<td>0.154</td>
<td>1.00</td>
<td>2.154</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>1.00</td>
<td>3.154</td>
<td>1</td>
</tr>
<tr>
<td>Castlegar</td>
<td>0.631</td>
<td>0.420</td>
<td>0.759</td>
<td>1.810</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>1.00</td>
<td>2.810</td>
<td>2</td>
</tr>
<tr>
<td>Nelson</td>
<td>0.596</td>
<td>0.490</td>
<td>0.681</td>
<td>1.767</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>1.00</td>
<td>2.767</td>
<td>3</td>
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<tr>
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<td>0.643</td>
<td>1.655</td>
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<td>Y</td>
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<td>Y</td>
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<td>Y</td>
<td>Y</td>
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<td>1.00</td>
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<td>N</td>
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<td>2.308</td>
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<td>Dawson Creek</td>
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<td>1.235</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
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<td>2.235</td>
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<td>Kitimat</td>
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<td>0.874</td>
<td>0.183</td>
<td>1.390</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>0.80</td>
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<td>1.000</td>
<td>0.095</td>
<td>1.267</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
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<td>1.867</td>
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<td>Smithers</td>
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<td>0.527</td>
<td>0.119</td>
<td>0.856</td>
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<td>Y</td>
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<td>Y</td>
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<td>0.399</td>
<td>0.857</td>
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<td>N</td>
<td>Y</td>
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Note: Parentheses in rank column denote the rank based on the quantitative suitability indicators only.
family physicians (presence of family doctors). Telemedicine was regularly used at the local hospitals in 15 of the communities. Meanwhile, only 11 of the 19 communities had demonstrated momentum for enhancing palliative care services through the creation of a proposal for a local residential hospice.

The findings displayed in Table 3 reveal several interesting results regarding the overall community suitability rankings. For example, no change in rank is observed in the top six communities between the original quantitative model and the new mixed methods model. Each of these communities also had all of the community readiness indicators present. Alternatively, the mid-ranked communities experienced the most change in rank. These communities had anywhere from five to two of the community readiness indicators present. As with the communities with the highest suitability ranks, those in the bottom two positions also did not change rank between the two models. As shown in Table 3, these communities, namely Whistler and Mackenzie, had little to no presence of the community readiness indicators.

Figure 1 illustrates the results of the siting model based on the inclusion of the community readiness indicators. Suitability rank changes are highlighted for each community, indicating whether the community’s suitability to be designated as a SPCH rose, fell, or remained static with the inclusion of the new indicators. Symbols are used to show the change in rank from the previous model; the number in the symbol indicates the community’s updated rank position.

Small differences in the results emerge when the findings of the two models are compared, including the decrease in suitability for Kimberley in the southeast of the province and Kitimat and Terrace in the northwest, in comparison with their neighboring communities. Also, the presence of all five readiness indicators increased the rank for two of the communities clustered in the northeast of the province: Dawson Creek and Fort St. John. To summarize, the most significant changes in rankings as demonstrated visually in Figure 1 have occurred in two clusters: (a) Terrace–Smithers–Prince Rupert–Kitimat (with Kitimat becoming noticeably less suitable) and (b) Fort St. John–Dawson Creek–Mackenzie (with Fort St. John becoming noticeably more suitable). With few significant or noticeable changes happening in communities between the original model and the revised model, the community readiness arm has served to complement the existing siting variables of population, isolation, and vulnerability.

**Discussion**

Demonstrated by the findings shared above, the mixed methods siting model introduced here has resulted in slightly different SPCH siting suitability rankings for rural and remote communities across BC. Changes are most pronounced for communities that are most distant from the highly populated southwest of the province and those that hold mid-level ranks, when compared with the rankings generated by the original quantitative model. The lack of significant differentiation between the findings of the two models is not seen as a shortcoming. Instead, inclusion of the community readiness “arm,” which is depicted in Figure 2, is of great importance because it responds to on-the-ground observations from community members. Thus, the revised model presented herein offers a more robust assessment of community suitability and readiness to be designated as a SPCH and ultimately enhance its local palliative care service provision.

**Revisiting the Mixed Methods Approach**

Given the forecasted increase in demand in developed countries for palliative services over the next 40 years, modeling optimal locations for enhanced service provision is a pressing challenge. The method described in this article is unique in that it incorporates both qualitative and quantitative attributes in a comprehensive palliative care siting model, this being a health service that has
received little attention from location allocation researchers both within human geography and beyond. Whereas the original SPCH model (Cinnamon et al., 2009) relied exclusively on quantitative factors (e.g., core population, isolation from existing services, and vulnerability), the present siting model incorporates data gleaned from personal interviews in rural and remote BC that serve to dimensionalize the earlier model. As such, it introduces a new level of complexity and nuance to the original model that is seldom associated with location or siting models. By adding five qualitative variables of community readiness and their associated indicators to the SPCH siting model, we have created a protocol for developing mixed qualitative and quantitative health service location models and a usable model for palliative care service siting. This is a significant contribution to the location analysis literature that has typically focused on quantitative indicators culled from secondary data sets alone.

The innovation described above contributes not only to the health services location literature but also to the growing mixed methods “movement” within human geography (Kwan, 2004).
The third methodological wave, involving incorporating both qualitative and quantitative data, has increasingly been supported theoretically within the discipline as geographers realize the benefit of incorporating lived realities and experiential data into previously quantitative models and analyses (Cresswell, 2009; Dunning et al., 2008; Kwan & Knigge, 2006; Sale et al., 2002). GIS-based analysis, in particular, has been reconstructed in the image of mixed methods research (e.g., Bell & Reed, 2004; Elwood, 2006; Hawthorne, Krygier, & Kwan, 2008; Knigge & Cope, 2006; Kwan, 2002; Kwan & Ding, 2008; Pavlovskaya, 2006). In this study, we extended the purview of mixed methods spatial analysis to include health services location analysis with a focus on palliative care. In the process, we adopted a prescriptive approach by which the final analysis suggests optimal locations for new services based on the mixed qualitative and quantitative factors incorporated into the model. This prescriptive approach enables the research to be of immediate value for health policy decision makers in BC and perhaps elsewhere. This is particularly relevant in a health services allocation climate that emphasizes informed decision making and evidence-based policy making. By using a mixed methods model, we enhance the likelihood that the prescriptive results will be palatable to administrators on both sides of the methodological divide.

Health care is, at present, a topical issue in many countries as existing delivery systems are being threatened by numerous demands, including the problems associated with an aging population and the need to incorporate technological and clinical advances in the face of skyrocketing costs. In Canada, the National Forum on Health has urged health care policy makers and administrators to base their strategies on the best available evidence (Canada Health Action, 1997). As

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**Figure 2. Revised mixed methods siting model**

Note: The figure visually represents the revised siting model run in the present analysis. The first three arms were part of the originally conceptualized quantitative model, whereas the fourth arm was added in response to findings from the qualitative data set. Indicators for the five variables were identified and the appropriate data were gathered to run the revised model.
the demand for public accountability with respect to service provision increases, the need for defensible data on which to base decisions has gained urgency (Baker et al., 1999; Dobrow, Goel, & Upshur, 2004; Gray, 2001). Not only is the siting model described in this article a mixed methods model, but it is also a nonhierarchical model that offers sound, defensible, data. By incorporating grassroots community input into the siting of health services, it defies the top-down trend in evidence-based decision making—in which analysts inform communities of results without prior consultation. Thus, the model not only supports informed decision making, but it also incorporates a broad and inclusive evidence base. This facet of the model may lead to health service allocation decisions that are more palatable and readily incorporated in rural and remote communities in the long run.

Limitations

The assignment of equal weights to each of the four factors in our model (population, isolation, vulnerability, community readiness), as well as the five community readiness indicators, may act as a limitation. However, in running the original quantitative model, sensitivity analyses were conducted whereby differing weights were assigned to the original three factors (population, isolation, vulnerability; see Cinnamon et al., 2009). The results of these analyses showed that differing weighting scenarios had little consequence for communities’ overall ranks. More specifically, the top three ranked communities had no change and no other community had a change in rank of greater than two spots. Based on these results it was decided to assign equal weights to each of the factors because there is no evidence available to support differential weighting based on importance. We have carried this decision forward in the present work on the mixed methods model as there still remain no adequate data that would assist with determining relative or absolute weighting. Furthermore, the qualitative data do not indicate that the community readiness variables should be weighted any differently in that none were discussed as being more important than others. Future qualitative data collection probing the relative weights of the community readiness indicators as well as the relative weights of the four arms of the overall model would be required before making any decisions regarding redistributing the equal weights.

Certain aspects of the qualitative data analysis may serve as a limitation. First, the analysis focused on agreement across participants and groups regarding the community readiness variables selected for inclusion in the model. Although we interviewed two different stakeholder groups, namely formal and informal palliative care providers, the present analysis did not tease apart their perspectives. The number of informal providers interviewed was small, and so we decided that a comparative analysis between the groups was not feasible. An even stronger reason for this decision, however, was the fact that congruence in viewpoints on an issue was significantly prioritized as this is what justified the inclusion of a particular community readiness variable and its subsequent indicator in the model. A second limitation is that the qualitative analysis was not particularly high level. For example, theoretical constructs were not used to guide the interpretation of the data. Instead, participants’ viewpoints were, for the most part, taken at “face value,” although more critical interpretations of the qualitative data set have been presented elsewhere (e.g., Castleden, Crooks, Schuurman, & Hanlon, 2010; Crooks et al., 2009). Though the analysis did not achieve significant depth in terms of offering new theoretical or conceptual perspectives, it did result in achieving important insights regarding the breadth of factors that inform community readiness for palliative care. These insights ultimately led to the useful refinement of the siting model based on community input and so justify the realist interpretation of the data employed in the analysis.

The use of binary indicators to express the presence or absence of the five variables of community readiness in the present analysis may serve as an additional limitation. We recognize that
such binary indicators may not capture the true breadth of the issues of relevance to the variables. At the same time, they serve as a useful starting point for incorporating community readiness into this model based on the qualitative interview data, thus recognizing the importance of this siting consideration identified by the participants. We were also limited to including only those variables for which a binary indicator could be identified. For example, the variable of “clinical support and diversity” (e.g., the presence of a local palliative care network or the capacity to develop a palliative care team) was suggested as important by participants. We developed the nonbinary indicator of “the number of professional groups involved in in-home palliative care provision in the community” to link to this variable, but could not find people who consistently had the knowledge required to respond to this question across the communities of focus. We were thus unable to obtain the required data to incorporate this variable into the model. Thus, our reliance on the incorporation of quantitative data into the GIS-based spatial analysis heavily restricted the types of indicators of community readiness we could gather, and also meant that community readiness variables identified within the qualitative data set that could not be quantified by an indicator were excluded from further consideration. Broadly speaking, the limitation at play here was our need to transform qualitative insights into quantitative indicators.

**Future Research Directions**

The findings presented herein provide a number of avenues for further research. The use of binary indicators in the siting model has been useful in advancing the inclusion of community readiness considerations. Future research on this model would be well served by experimenting with the inclusion of nonbinary data, for example, Likert-type scale data that probe the existing and/or new variables and their indicators, in linking data to the community readiness. Likert-type scale data could also assist with testing the internal consistency of the community readiness variables. Additional primary data collection with formal and informal palliative care providers in the communities of focus would also be useful so that other on-the-ground siting factors could be further identified and probed. This would be particularly useful given that participants were not given the details of the existing quantitative siting model in the interviews that they could then augment by suggesting further siting variables to be considered for inclusion. The mixed methods siting model would also be well served by conducting further primary data collection in rural and remote regions in BC or other Canadian provinces so as to confirm the variables and indicators currently summarized in Figure 2 or to refine the model with the inclusion of additional variables. The perspectives of other stakeholder groups, including consumer perspectives and end-user or decision-maker perspectives, could usefully be gathered to assist with such confirmation. Their insights may also assist with developing a more dynamic “vulnerability” arm in the model, which is presently limited to considering the proportion of the population aged 65 years and older. We recognize this is a very limited view on who is vulnerable to needing palliative care, but this aspect of the model cannot be expanded on without additional primary data collection.

The model discussed herein has focused on enhancing palliative care services in both rural and remote BC communities. The findings, as displayed in Table 2 and illustrated in Figure 1, show that those communities that are more remote in nature—such as the clusters in the northeast and northwest of the province—are less suitable to host SPCHs when compared with their rural counterparts. However, it would not be accurate to interpret these communities to be in less need, per se, of service enhancement than rural communities that typically have larger regional populations and more extensive transportation networks. It is more likely to be the case that further consideration needs to be given to teasing apart the needs of rural communities from those of remote communities, or potentially their differential favoring in the current siting model,
and to develop a model that can better accommodate both community types. This recognition serves as an implication not only for the model presented in this article but also for all health service siting models that must be applied to a range of community types (e.g., urban, suburban, rural, remote).

**Conclusion**

This study was developed to enhance and dimensionalize a prototype quantitative location model for siting SPCHs. The goal of this enhanced model was to incorporate qualitative and quantitative data following theoretical developments in the discipline of geography over the past decade that have advocated for the use of mixed methods approaches, including that involving GIS. To do this, we incorporated interview data and insights from stakeholder respondents across rural and remote BC regarding their community’s readiness to host enhanced palliative services. We extracted five separate community readiness variables from this qualitative data set and incorporated their respective indicators into a health services location model. The result is an enhanced protocol for developing location models for health services—one that integrates a range of indicators.

An important implication of the mixed methods protocol developed herein is that it is likely to appeal to a broader range of decision makers than the previous quantitative model—namely those in both the qualitative and quantitative methodological camps. Likewise, the decisions supported by the mixed methods model may be more easily assimilated by recipient communities, given that their responses have provided the basis for a key arm of the revised siting model. This is a preliminary attempt to incorporate mixed methods into a health services location model and there is clear room for future research and methodological innovation. We look forward to extending these methods to other health services and incorporating a greater range of community stakeholder responses.

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**Declaration of Conflicting Interests**

The author(s) declared no potential conflicts of interests with respect to the authorship and/or publication of this article.

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