

# Access to radiotherapy among circumpolar Inuit populations



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Cancer is a substantial health burden for Inuit populations, an Indigenous peoples who primarily inhabit the circumpolar regions of Alaska, Canada, Greenland, and Russia. Access to radiotherapy is lacking or absent in many of these regions, despite it being an essential component of cancer treatment. This Review presents an overview of factors influencing radiotherapy delivery in each of the four circumpolar Inuit regions, which include population and geography, health-systems infrastructure, and cancer epidemiology. This Review also provides insight into the complex patient pathways needed to access radiotherapy, and on radiotherapy use. The unique challenges in delivering radiotherapy to circumpolar Inuit populations are discussed, which, notably, include geographical and cultural barriers. Recommendations include models of care that have successfully addressed these barriers, and highlight the need for increased collaboration between circumpolar referral centres in Alaska, Canada, Greenland, and Russia to ultimately allow for better delivery of cancer treatment.

## Introduction

Inuit are an Indigenous peoples whose homelands, or Inuit Nunaat, comprise the circumpolar (Arctic) regions in four countries: USA (Alaska), Canada (Inuvialuit [Northwest Territories], Nunavut, Nunavik [northern Quebec], and Nunatsiavut [northern Labrador]), Denmark (Greenland, a part of Denmark with self-government), and Russia (Chukotka; figure 1).<sup>2-4</sup> Many of these countries are considered high-income; however, substantial disparities exist because Inuit populations have a higher prevalence of cancer and mortality across several types of cancer compared with the general population.<sup>5-9</sup> Although radiotherapy is an essential component of comprehensive cancer care,<sup>10</sup> no radiotherapy services exist in many Inuit regions, requiring patients with cancer to travel long distances to receive treatment. This Review presents the status and delivery of radiotherapy services for Inuit communities across the circumpolar north, and discusses some of the unique challenges in providing radiotherapy to this population.

## Population and geography

Inuit populations share a similar cultural background, having originated from east Asia.<sup>11</sup> Following Inuit Circumpolar Council definitions, this Review terms Inuit as the regional groups of the Iñupiat, Yupik, and Cup'ik (Alaska), Inuit (Canada), Kalaallit (Greenland), and Yupik (Chukotka).<sup>4,12,13</sup> The total Inuit population is about 160 000,<sup>13</sup> with the largest groups living in Greenland and Nunavut, Canada.<sup>5,14</sup> Inuit communities make up a small proportion of their respective country's total population (1% or less) yet more than three-quarters live in relatively well defined geographical regions typically in the northern areas of the country (table 1).<sup>15-27</sup>

The geographical area inhabited by Inuit populations spans a total of over 4·5 million km<sup>2</sup>, which results in low population densities.<sup>15-19</sup> For example, Greenland is the world's largest island and has the lowest population density in the world; 90% of the population are Inuit.<sup>18</sup> Much of the regions inhabited by Inuit populations are covered by ice or tundra, with a typical Arctic climate consisting of long winters and short summers. Although

the largest city among all Inuit regions is Greenland's capital of Nuuk, with a population of about 17 000,<sup>18</sup> most Inuit do not reside within the largest cities, but rather in smaller coastal towns, villages, or settlements scattered throughout the circumpolar regions. As a result, subsistence (eg, hunting, fishing, whaling, and collecting) plays a substantial role for many Inuit communities in terms of their cultural, material, and economic well-being.<sup>3</sup> In addition, roads are not ubiquitous, resulting in air and ship being some of the most common methods of transportation.

## Overview of health systems

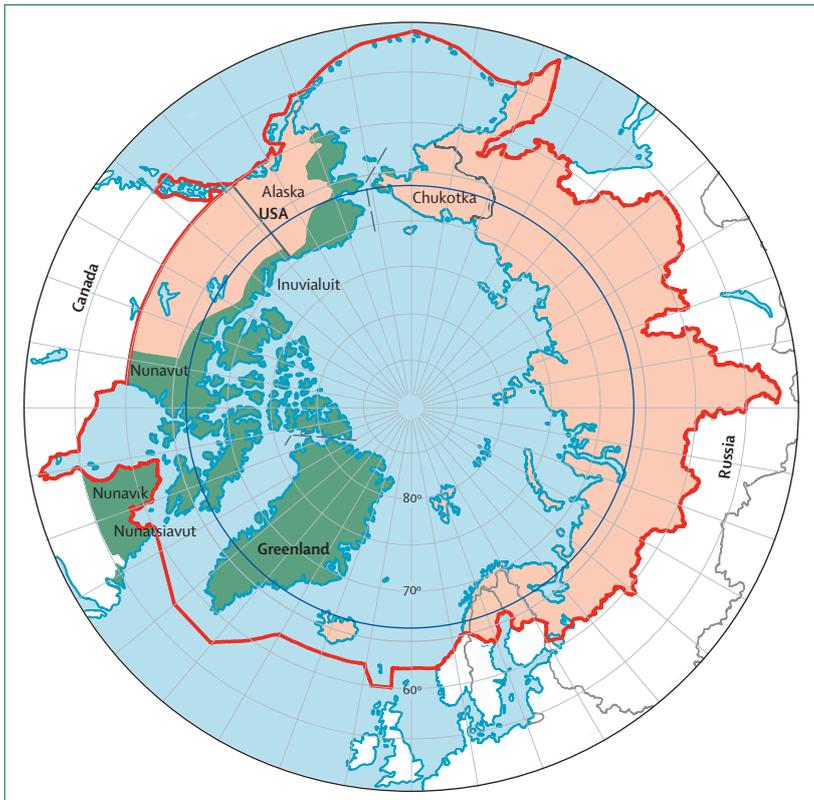
The health systems within each circumpolar country appear remarkably different, with a diverse mix of public and private models. Health care in Alaska (part of the USA) is largely private, with personal health insurance playing an important role in funding. Health service provision for all Indigenous groups across the USA, including Inuit, falls under the federally funded Indian Health Service.<sup>2</sup> In 1971, Alaska Native people formed and became shareholders of 13 for-profit regional corporations, each of which established non-profit health care in their respective regions, subcontracting non-Alaska Native organisations to provide health care. In the following decades, Alaska Native people assumed complete ownership of health services from the Indian Health Service in Alaska, such that all Alaska Native health care has been provided by Alaska Native organisations since 1998.<sup>28</sup> The resulting Alaska Tribal Health System is now overseen by the Alaska Native Tribal Health Consortium, which is owned and managed by Alaska Native people.<sup>29</sup> Therefore, Inuit populations within Alaska can have coverage for health-care services, including all radiotherapy treatments, through state and federal government-funded insurance programmes, such as Medicare and Medicaid, but also through the Indian Health Service, tribally sponsored health insurance, or private insurance, creating a truly complex health system for this population.

Canada and Greenland both have national, universal government-funded health-care systems.<sup>2</sup> In 1992,

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**Figure 1: Inuit Nunaat within the circumpolar world**

The Arctic Circle is denoted by the bold latitude in blue. Areas shaded in red within the red outline represent the circumpolar world, as defined by the Circumpolar Health Observatory.<sup>1</sup> Areas shaded in green represent the Inuit homelands ("Nunaat"), as defined by the Inuit Circumpolar Council.<sup>4</sup> The Inuit regions in the USA are North Slope Borough, Northwest Arctic, Nome, and Yukon-Kuskokwim Delta in Alaska (state). In Canada the Inuit regions are Inuvialuit in the Northwest Territories (territory), Nunavut (territory), Nunavik in Québec (province), and Nunatsiavut in Newfoundland and Labrador (province). The Inuit region in Denmark is Greenland (a part of Denmark with self-government), and in Russia is the Chukchi Peninsula in Chukotka (autonomous region). Reproduced and adapted with permission from Young and colleagues.<sup>1</sup>

responsibility for health care was transferred to Greenland from Denmark,<sup>30</sup> and because Inuit form the majority of the population, all are covered under this plan, including radiotherapy. In Canada, health care is administered by the country's 13 territories and provinces through predominantly public but also some private funding. In 1988, the Northwest Territories (which included Nunavut, until it was made its own territory in 1999), accepted responsibility for health care from the federal government.<sup>2</sup> The organisation and financial management of health services for Nunavik are carried out by the Nunavik Regional Board of Health and Social Services, which is governed by Inuit; for Nunatsiavut, responsibilities are shared between health authorities, including the Nunatsiavut Government's Department of Health and Social Development and the provincial entity Labrador Grenfell Health.<sup>2</sup> All Indigenous populations, including Inuit, are covered by the universal health-care system for radiotherapy. Most other services that are not covered can be subsidised by the federally funded Non-Insured Health Benefits Program,<sup>31</sup> rather than through private funding.

Russia inherited a centralised health-system infrastructure from the Soviet Union in 1991. A reform in health financing led to the replacement of public expenditure on health with out-of-pocket expenses and mandatory health insurance obtained through general tax and payroll contributions.<sup>32</sup> Despite ongoing efforts to improve financing of the health system in Russia, inequality in both distribution of health-care resources and access to health services is increasing where the large majority of Inuit communities are located.<sup>2,32,33</sup> Basic health services for the Russian population, including Indigenous peoples in Chukotka, are covered by mandatory health insurance. However, this coverage is limited to basic radiotherapy (eg, two-dimensional planning techniques) and excludes combination therapies (eg, chemoradiation). Patients who require more advanced radiotherapy or combination treatments (so-called high-technology treatments) need approval and enrolment in a separate insurance programme, which can in theory cover the financial cost of treatment, although it can be challenging to obtain because of substantial paperwork, approval processes, and time. As a result, many people resort to out-of-pocket expenses to access such treatments.

Overall, despite differences in the health-care systems, Inuit populations in each circumpolar region have secured financial coverage for health care in partnership with the respective country's governments. This coverage includes all radiation treatments and travel costs to a cancer centre, even if the facility is outside the patient's region. Although these costs generally correlate with higher health-care expenditures, they do not necessarily result in better health outcomes. For example, in the northern regions of Greenland where a large proportion of the Inuit population reside, health expenditures per capita are higher compared with the national average,<sup>14</sup> but life expectancy is between 6 to 11 years lower for Inuit populations across all four countries. In 2010–14, the life expectancy in Greenland was 69·1 years versus 78·1 years in Denmark for men and 73·7 versus 82·1 years for women.<sup>1,34</sup> This disparity is probably due to a broad range of social, historical, health, economic, and environmental factors, and reflects the status of many Indigenous groups worldwide.<sup>2,35</sup>

### Cancer epidemiology

The prevalence of cancer among Inuit populations has continued to rise in the past several decades.<sup>5,11,36</sup> This pattern can be partially attributed to changing living conditions and lifestyle factors, including a gradual move from a traditional diet that is reliant on an active subsistence way of life, to an increasing incorporation of processed foods, a less active lifestyle, and tobacco consumption.<sup>11</sup>

The increased prevalence of cancer has been observed for lung, colorectal, and breast cancers among Inuit populations from Alaska, Northwest Territories,

	USA	Canada	Denmark	Russia
	Alaska (state): North Slope Borough, Northwest Arctic, Nome, and Yukon-Kuskokwim Delta	Inuvialuit in the Northwest Territories (territory), Nunavut (territory), Nunavik in Québec (province), and Nunatsiavut in Newfoundland and Labrador (province)	Greenland (a part of Denmark with self-government)	Chukotka* (autonomous region)
<b>Geographical area</b>				
Inuit regions (km <sup>2</sup> ) <sup>15-19</sup>	575 571	1 536 800	2 166 086	721 500
Country (km <sup>2</sup> ) <sup>20</sup>	9 833 517	9 984 670	2 210 573*	17 098 242
Percentage of country's total area that are Inuit regions	6%	15%	98%	4%
<b>Population</b>				
Total population of country (in 2018) <sup>20</sup>	329 256 465	35 881 659	5 918 211†	142 122 776
Total Inuit population in country (year data collected) <sup>21-24</sup>	37 842 (2000)	65 030 (2016)	66 641 (2018)‡	1750 (2002)
Total Inuit population living in Inuit regions (year data collected) <sup>22,25-27</sup>	35 069 (2000)	47 330 (2016)	50 171 (2018)§	1529 (2010)
Percentage of the country's population that are Inuit	<0.01%	0.2%	1.13%	<0.01%
Percentage of the country's Inuit population living in Inuit regions	93%	73%	75%	88%
<b>Population density</b>				
Country (persons per km <sup>2</sup> )	33.48	3.59	2.68	8.31
Inuit in Inuit regions (persons per km <sup>2</sup> )	0.06	0.03	0.02	0.002

\*Entire region of Chukotka. †Includes Denmark, Greenland, and the Faroe Islands. ‡Includes 16 470 people born in Greenland and living in Denmark. §Based on Greenland at place of birth (no Inuit identifiers).

**Table 1: Geographical and population indicators across the four circumpolar Inuit regions**

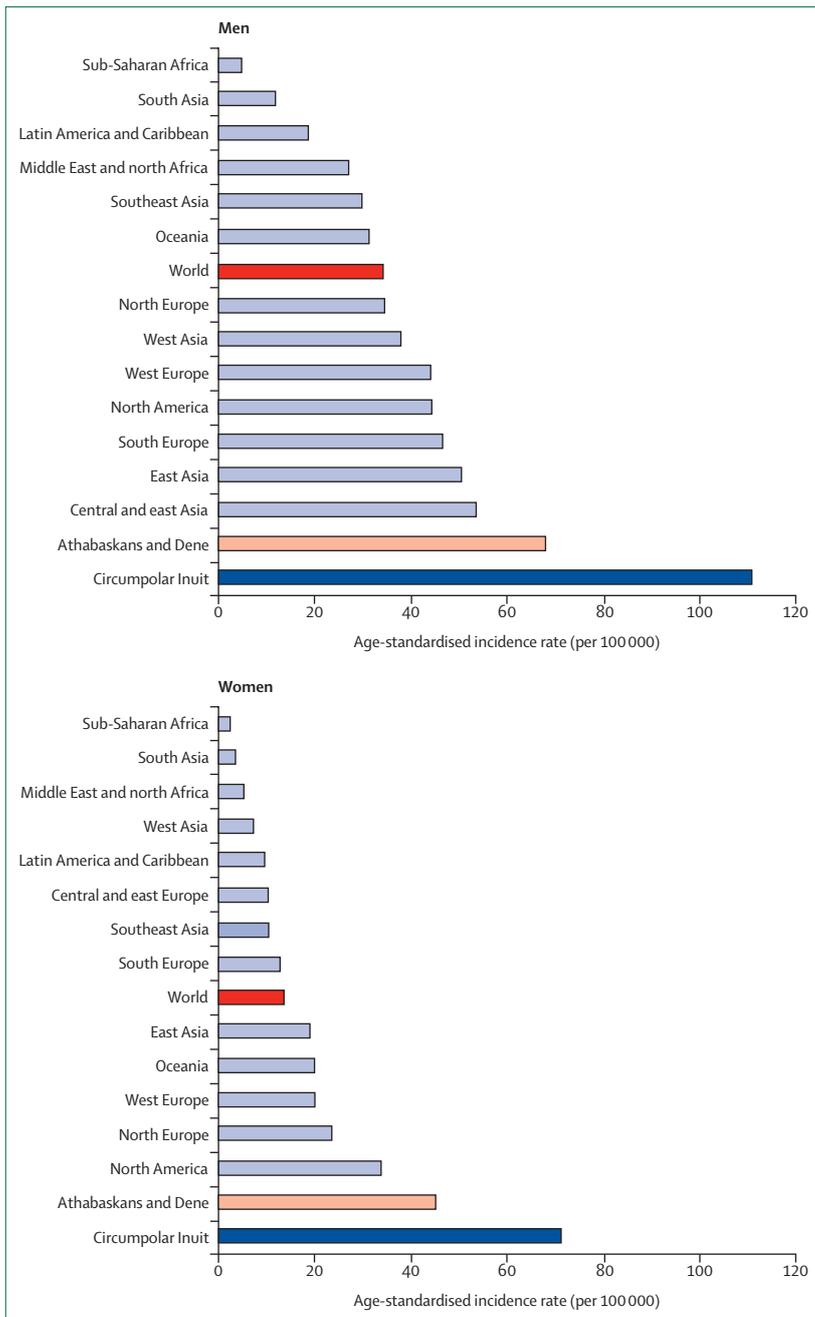
Nunavut, and Greenland combined, with these regions having the highest prevalence of lung cancer in the world (figure 2).<sup>5</sup> Nunavut leads the circumpolar regions with the highest lung cancer rates (age-standardised incidence rate of 123.0 and 121.6 per 100 000 for males and females, respectively),<sup>1</sup> while prevalence of lung cancer is also high in Chukotka and among Chukotka Inuit.<sup>36,37</sup> In addition, a higher incidence of oesophageal and gastric cancers have been noted among several Inuit populations and regions compared with other Nordic countries, white Americans, and the general population in Russia.<sup>7,36-38</sup> Inuit populations are at extremely high risk compared with the world average for typically rarer cancers such as nasopharyngeal carcinoma, which is probably the result of environmental factors (eg, Epstein-Barr virus and diet), in combination with a particular genetic constitution, although further research is required to understand these relationships.<sup>5,7,11</sup> On the contrary, despite the high incidence of cervical cancer in Greenland, the prevalence of cervical cancer has decreased among Inuit women overall.<sup>5,7</sup> Inuit men also continue to be at low risk of prostate cancer, typically a common cancer among men in the general population.<sup>5,11</sup>

Cancer is the leading cause of death among Inuit populations in Alaska, Canada, and Greenland, and is the third leading cause of death in Chukotka, for both sexes combined (table 2).<sup>7-9,34,39-41</sup> More than half of excess mortality among Inuit populations in Canada is attributable to cancer,<sup>42</sup> and all cancer age-standardised mortality rates in each Inuit region are significantly higher compared with the general population in their

respective countries.<sup>7,8,34,39</sup> Lung cancer is the leading cause of cancer mortality in all Inuit regions.<sup>7-9,39</sup> In Greenland, both respiratory and gastrointestinal cancers account for 55% of all cancer deaths among women, and nearly 70% among men.<sup>7</sup> Inuit patients with cancer have been reported to present at a younger age at diagnosis compared with the general population,<sup>38,43</sup> and are more likely to present with advanced stage disease,<sup>44-48</sup> although this stage difference was not found in all studies.<sup>49</sup>

### Radiotherapy services and delivery

Referral pathways are established in all four circumpolar regions so that patients can access basic health care in or close to their home community, further assessment and work-up at regional health centres and territorial or state hospitals, and, if needed, cancer treatment at larger oncology referral centres (figure 3).<sup>28,30,50</sup> Alaska and Greenland have a centralised referral pathway system, where patients are directed to a state referral centre such as the Alaska Native Medical Center, which is also the oncology referral centre, in Anchorage, Alaska, and Queen Ingrid's Hospital in Nuuk, Greenland, (followed by a transfer to Rigshospitalet in Copenhagen, Denmark, if required, because radiotherapy is not available in Nuuk). Russia and Canada have a less centralised referral pathway, where patients can be referred to different cities depending on patient preference and treatment complexity. For example, large urban centres (such as those in Moscow) have the capacity to provide all advanced radiation treatments, whereas a city closer to Chukotka, such as Yakutsk, can only provide basic radiotherapy covered



**Figure 2: Lung cancer incidence for circumpolar Inuit compared to global regions for men and women**  
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under the mandatory health insurance. In Canada, patients are referred to the closest oncology centre depending on their region of residence. These patient referral systems evolved from agreements between territorial, provincial, and regional health authorities, in addition to already established historical flight patterns.<sup>51</sup>

All radiotherapy consultations, treatments, and most follow-ups can only be done at oncology referral centres

in larger urban centres at the end of the referral pathway. In addition, a patient's first point of contact with any oncology provider does not generally occur until they reach a hospital that is large enough to also provide radiotherapy. One exception is Queen Ingrid's Hospital in Nuuk, where internists have been delivering cancer treatment for most lung, breast, and colorectal cancers since 2004, including certain regimens of chemotherapies.<sup>7,49,52</sup> A second exception is Anadyr in Chukotka, where outpatient clinics staffed by one to two oncologists can provide initial consultations, but no treatment. Although certain chemotherapy regimens can be administered in Yellowknife, Northwest Territories, and Happy Valley-Goose Bay, Newfoundland and Labrador, there are no oncologists or cancer centres in these regions, and the first cycle is given at the oncology referral centres.<sup>53</sup> Obtaining a CT scan is possible in all territorial and state hospitals across the circumpolar regions, with Iqaluit, Nunavut receiving their first CT scanner in 2014.<sup>54</sup> If possible, cancer biopsies are done at the territorial or state hospitals, but many biopsies occur at the referral centres. All pathological evaluation is conducted at the referral centres.

An established community-based practice for radiation oncology is the exclusive radiotherapy provider for Alaska Native patients under the Alaska Tribal Health System, having been contracted by the Alaska Native Tribal Health Consortium in 2010. The centre's main location is in Anchorage, with a satellite centre between Palmer and Wasilla. Across both locations, the centre is equipped with five treatment units (linear accelerators, GammaKnife radiosurgery, and high-dose rate brachytherapy).

The five Canadian radiation oncology centres that provide radiotherapy to the Inuit Nunangat vary in size. St John's has six treatment units (linear accelerators, high-dose rate brachytherapy, and orthovoltage), whilst Ottawa, the largest centre, has 14 treatment units (linear accelerators, Cyberknife, high-dose rate brachytherapy, and orthovoltage). The Rigshospitalet in Copenhagen, Denmark, provides radiotherapy for the Greenlandic population and has 13 treatment units (linear accelerators, low-dose rate brachytherapy, and orthovoltage).

In all regions, Inuit patients with cancer are generally treated along the same clinical pathway and are offered the same treatment options as the general population within the referral oncology centre's catchment area, following national and international standards of care and treatment. However, as mentioned earlier for Russia, only two-dimensional and radiation-only treatments are offered as part of the mandatory health insurance coverage, which most Indigenous patients from the Chukotka region fall under. In addition, radiotherapy might be limited to incorrect periods of time, and interruptions in treatment can be frequent. The main reasons for incomplete treatment include technical issues due to lack of adequate services, including outdated equipment and under staffing of medical

	Alaska*	Canada†	Greenland‡	Chukotka§
Leading causes of death (all causes; year shown) <sup>34,39-41</sup>	(1) Cancer; (2) heart diseases; (3) unintentional injuries (2016)	(1) Cancer; (2) suicide and self-inflicted injuries; (3) circulatory diseases (2009-13)	(1) Cancer; (2) heart diseases; (3) respiratory diseases (2015)	(1) Injury; (2) circulatory diseases; (3) cancer and respiratory diseases (1996-2000)
Magnitude of all-cancer ASMR compared to the national population (year shown) <sup>2,8,34,39</sup>	1.5 (2007-16)	2 (2009-13)	2 (1983-2014)	2 (men), 3.5 (women; 1961-90)
Leading causes of cancer mortality (year shown) <sup>7-9,39</sup>	(1) Lung; (2) colorectal; (3) gastric (men) and breast (women; 2005-14)	(1) Lung; (2) colorectal (2009-13¶)	(1) Lung; (2) gastrointestinal; (3) female genital (1983-2014)	(1) Lung; (2) oesophagus; (3) gastric (1961-90)

Both sexes combined unless otherwise stated. ASMR=age-standardised mortality rates. \*Alaska Native and American Indian population residing in Alaska. †Population residing in the Inuit Nunangat (Inuit and non-Inuit). ‡Population residing in Greenland (Inuit and non-Inuit). Causes of death excluding "other" category. §Indigenous peoples. ¶Data for other cancer types unreliable because of small numbers.

**Table 2: Leading causes of death and cancer mortality among circumpolar Inuit**

physicists, dosimetrists, and radiation therapists,<sup>55</sup> and administrative issues including a scarcity of financial support, which is particularly the case in less populated cities.

The literature on access to radiotherapy among Indigenous populations, and in particular Inuit populations, is limited. Some basic usage data are available, although the population groups vary across studies, making a comparison of usage difficult. In a chart review<sup>56</sup> of Inuit patients from Nunavut between 2000 and 2010, 117 (38%) of 307 Inuit patients diagnosed with cancer were treated with radiotherapy in Ottawa, either alone or in combination with chemotherapy or surgery. Of 125 Greenlandic patients diagnosed with head and neck carcinoma from 1994 to 2003, 114 (91%) received either surgery or radiotherapy in Copenhagen.<sup>46</sup> Although there are no studies describing radiotherapy use among the Indigenous populations in Chukotka, overall use in Russia is low, at about 30%, and is probably even lower in Chukotka given the substantially decreased access to medical care in rural areas.<sup>57</sup>

### Challenges and opportunities

Despite having financial coverage, the accessibility of radiotherapy to Inuit populations depends on both geographical and cultural considerations. Select models of care that have been implemented in certain regions that address access to therapy might serve as potential opportunities for other circumpolar regions.

### Geographical considerations

Providing health services to small and scattered populations across a vast geographical area is one of the most challenging issues faced by health-care providers in the Arctic. This challenge is particularly true for radiotherapy because all radiotherapy centres are at the end of the referral pathway, necessitating substantial travel for circumpolar Inuit patients to access this treatment from their home communities. With no road access in most regions, the only option for travelling is by flight, which might only depart from a community twice per week. Inuit patients in Greenland, for example, must fly up to 4 h from their community to Nuuk, and an additional

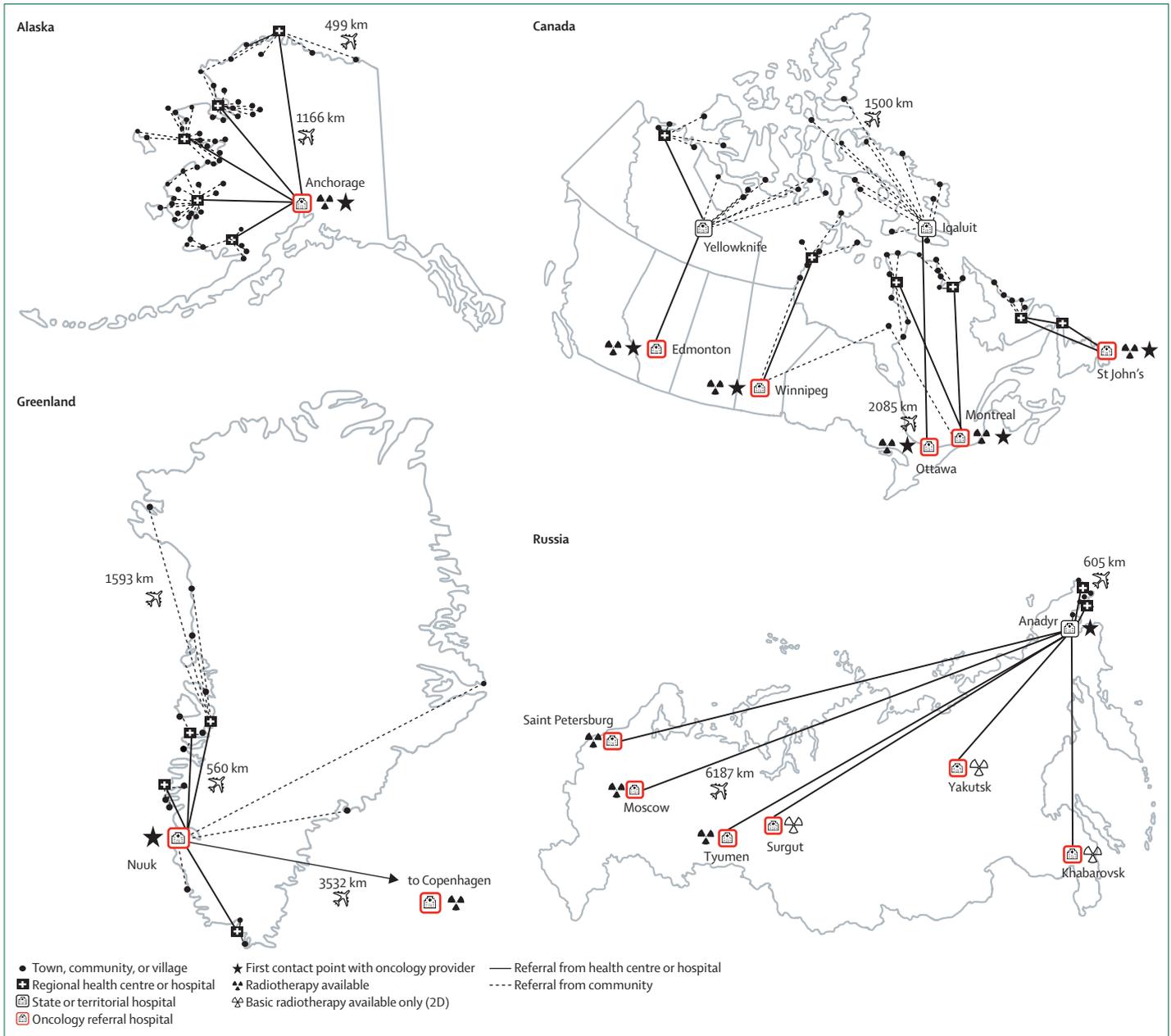
4-5 h from Nuuk to Copenhagen for radiotherapy. Additionally, harsh Arctic weather conditions can substantially affect flights; prolonging travel time.<sup>29,30,41</sup>

The costs associated with medical travel are substantial. For example, spending on medical travel was one third of the total operational budget for the Government of Nunavut Department of Health in 2014-15,<sup>58</sup> and was 12% of Greenland's total expenses for health care in 2008.<sup>30</sup> In Alaska, costs of living in small rural communities are more than 50% of that in Anchorage, which also affects the costs of service provision.<sup>28</sup>

Substantial travel burden might influence treatment decisions for both patients and local providers. In Canada, 14% of residents in Inuit Nunangat felt they needed health care but did not receive it, versus 10% in the general Canadian population, with the most common reason being the unavailability of service in their area.<sup>59</sup> From a providers' perspective, the decreased availability of radiotherapy might influence referral and practice patterns. For example, most Greenlandic patients with breast cancer have been up until recently treated with mastectomy, because breast-conserving surgery (typically followed by adjuvant radiotherapy) was not an option for treatment for patients in Nuuk.<sup>7</sup> In addition, patients' and providers' awareness of radiotherapy as a treatment option might be limited, particularly as the patient's first point of contact with an oncology provider is typically not until the end of the referral pathway.

Several potential solutions can be explored to address these geographical barriers. Establishing outreach radiotherapy clinics to provide increased access for rural populations has been shown to improve usage in countries such as Canada and Australia.<sup>60,61</sup> Although this result is encouraging, this strategy might not be feasible in the Arctic because of low population densities and the remoteness of where Inuit communities are located. In addition, whereas visiting specialists are common among the circumpolar communities, historically, radiation oncology has not participated in this model of care.

Increasing the number of local medical providers with experience or knowledge in oncology at the regional, or state and territorial level is another potential solution. This strategy might help reduce patient travel by



**Figure 3: Typical patient pathways from Inuit communities to radiotherapy centres among four circumpolar regions**

Distances represent the longest pathway in each country. Only large Greenlandic towns are shown. Not all communities are represented, and this figure does not provide an exhaustive list. Data from Sherry,<sup>28</sup> Bjerregaard,<sup>30</sup> and Pauktuutit Inuit Women of Canada.<sup>50</sup>

providing cancer therapy locally and establishing a point of contact who can help triage patients and discuss options for radiotherapy, without needing patients to travel to the oncology referral centre. For example, several internists with training in oncology are based in Nuuk at the Queen Ingrid's Hospital, and are in close communication with oncologists from Copenhagen, who in turn make yearly visits to Nuuk. In the first 6 to 8 years following provision of cancer therapy in Nuuk, survival for patients with lung and colorectal cancers, respectively,

is comparable to other Nordic countries.<sup>49,52</sup> This model has also shown success in other specialties, such as otorhinolaryngology, where the establishment of a permanent specialist in Nuuk in 2005 contributed to substantially faster referral times from Nuuk to Copenhagen for a cohort of Inuit patients with head and neck cancer, probably leading to substantially shorter diagnostic delays.<sup>45</sup> Because rapid turnover and retention of staff are common problems in the circumpolar regions,<sup>62</sup> this solution might not work for every region.

In such cases where the retention of local specialists is not feasible, strategies to improve support for local general practitioners should be considered, such as increased education and stronger communication lines with oncologists at the referral centres. For example, in Alaska, a distance learning network to deliver online health-care education to community health aides working in remote villages has been successfully established.<sup>63</sup> A similar model could be used to deliver oncology-based education to general practitioners and other health-care staff working in Inuit communities.

Telemedicine has played a key role in delivering health care in the Arctic, and has a high potential to improve quality, access, and costs in this setting.<sup>30,64</sup> Oncology referral centres across the four circumpolar countries and the respective Inuit regions are equipped with the technology to carry out appointments via telemedicine, except in Russia, where less than 3% of all health-care facilities have the capacity to use telemedicine.<sup>57</sup> Only some oncology referral centres (Anchorage, Winnipeg, and Newfoundland) use telemedicine for radiotherapy-related appointments. Where implemented, these programmes have been successful; for example, in Newfoundland, the radiation oncology programme is the highest user of teleoncology within the department of oncology, including consultations with patients who reside in Inuit communities whenever possible.<sup>65</sup>

Despite these successes, effectively implementing and sustaining real-time telemedicine in the Arctic is challenging and might not be feasible everywhere because of issues with the available communications technology, network infrastructure, adequate staffing to operate local telemedicine units, and cross-jurisdictional licensing.<sup>64,66</sup> Other technological innovations that might be less resource-intensive include eConsultations, a web-based platform that allows primary care providers to submit patient-specific clinical questions to a specialist. This model resulted in a 35% reduction of specialist visits that were originally intended to be face to face for patients from Nunavut, and results in a saving of CAN\$1100 per eConsult.<sup>66</sup> Most importantly, this platform does not require the technological infrastructure to support real-time interaction, but can still provide relatively quick access to specialists, who responded in a median of 0·9 days.<sup>66</sup>

### Cultural considerations

In addition to geographical barriers, cultural factors might also affect patient treatment decisions. Many Inuit communities have deeply rooted caregiving traditions where those who are sick are collectively cared for by family and community. The cultural shock that can accompany relocating from a small community to a large urban setting for radiotherapy might be challenging for many Inuit patients, especially because patients are not always granted an accompanying person for their medical travel and appointments. The possibility of

needing to leave one's family, home, and community to receive radiotherapy, often alone, in a large urban centre might discourage patients from pursuing such treatment options.

Considering these cultural barriers, many oncology referral centres have developed resources to support Inuit patients travelling from their home communities for appointments and treatments. In most cases, Inuit patients have lodging and transportation to the hospital financially provided for. Local country foods might be available at the lodge, and elders might also be present on site for patient support. Notably, Indigenous patient-navigators play a key role in supporting patients while they are residing in urban centres for treatment, and case managers dedicated to Inuit patients travelling from circumpolar communities help with coordinating flights, scheduling appointments and interpreters, and finalising follow-up and discharge plans if possible. Many of the nursing staff and case managers originally come from, or have worked in, Inuit communities themselves, and the resulting familiarity and understanding of Inuit culture can be used to effectively support Inuit patients. One successful model, for patients from Kivalliq travelling to Winnipeg, includes integrating the case managers' office within the patient lodge itself, which provides another level of direct support to Inuit patients, and can help in the early identification of any medical issues.<sup>53</sup>

Such initiatives are promising, but there are still many gaps in addressing present cultural barriers. Notably, substantial language barriers exist for Inuit patients when communicating with specialists,<sup>67</sup> as most specialists in large urban referral centres do not speak an Inuit language.<sup>30,47</sup> Similarly, the lack of appropriate cancer-related terminology remains a barrier. Historically in Canada, for example, the word for cancer in Inuktitut is "cannot be fixed or healed",<sup>67</sup> which has resulted in fear, and might discourage Inuit patients and community members from discussing such topics openly and from actively seeking treatment.<sup>67</sup> This language barrier also presents challenges for providers in effectively communicating often complex technical treatment information to allow patients to make informed decisions. Recent initiatives to introduce language-specific materials such as cancer glossaries have been established by national organisations, including the Pauktuutit Inuit Women of Canada, in the hope of improving patient-provider communication; these materials now include a more positive word for cancer, which means "out of natural order" in the Inuit language.<sup>68,69</sup>

Although interpreters are available to alleviate some of the language barriers for most Inuit patients, and despite their critical role as a link between patient and provider, little information exists in the literature describing their experiences, effectiveness, and challenges in facilitating communication between patient and provider. In Nunavik, Canada, interpreters involved in end-of-life care often described receiving no formal training, with few

**Panel: Key recommendations to improve access to radiotherapy services for circumpolar Inuit populations**

**Telemedicine**

- Leverage existing programmes and expand use in radiotherapy, or consider establishing a programme if one does not exist
- Explore other online platforms if telemedicine is not feasible

**Visiting specialists**

- Consider establishing a model that incorporates visiting specialists from referral centres, establishes local specialists, or enhances collaboration and communication between local providers and specialists

**Cultural resources**

- Develop and provide language-specific radiotherapy and cancer resources for Inuit patients at referral centres, and implement cultural competency training for health-care providers
- Engage Inuit rights-holders in all processes including research, priority setting, policy making, and decision making

**Hypofractionation**

- Encourage the use of hypofractionation among radiotherapy providers at referral centres whenever suitable to reduce treatment times

**Clinical databases**

- Establish databases to monitor and evaluate cancer treatments across the Arctic, as a first step in providing data to describe radiotherapy use and outcomes among circumpolar Inuit populations
- Establish qualitative studies that include Inuit patients' experiences with cancer treatment

resources to explain complicated concepts. In addition, difficult conversations that involve topics of death and terminal diagnoses are typically held by community leaders and elders, placing interpreters under high moral distress.<sup>70</sup> Other Inuit traditions and beliefs that might affect health might also be unrecognised by oncology providers.<sup>47,71</sup> For example, some Inuit patients might delay, interrupt, or forego radiotherapy during subsistence seasons to enable them to stay at home and provide food for their families. Clearly, cultural differences exist that radiation oncologists might not be trained to recognise and approach appropriately, because they typically train and practise in larger urban cities where cultural competency training might not be mandated.

Finally, the intersection of cultural barriers with geographical factors is worth exploring. Both factors might influence access to treatment and contribute to treatment delays, which were reported to be 201 days from date of first symptom to start of treatment among Greenlandic patients with head and neck cancer,<sup>45</sup> and

10 weeks from diagnosis to start of treatment among Alaska Native patients with cancer.<sup>72</sup> Public health interventions, and increased public and provider education are upstream strategies that can help reduce the time from symptom to treatment, and should be established with follow-up to determine their effectiveness. However, at the level of specialist care, to provide timely medical management and to prevent lengthy stays away from home, appointments for Inuit patients are often scheduled back-to-back over a short time period. This scheduling might inadvertently result in patients becoming overwhelmed with information, particularly for a first diagnosis of cancer and being required to make treatment decisions quickly. The complex language of cancer, as well as cultural barriers, and isolation from family and friends presents a substantial challenge in delivering successful cancer care for Inuit populations. High levels of dissatisfaction were reported among caregivers of Greenlandic patients with advanced cancer, who were unable to reliably contact health-care professionals and could not be included in decision making around treatment.<sup>73</sup> Approaches to reduce time spent away from home could focus on addressing treatment times, such as through hypofractionation of radiotherapy. This method reduces the number of treatments required, with no evidence of increasing toxicity or poorer outcomes in radical breast and prostate treatments,<sup>74,75</sup> and in palliative settings across multiple disease sites.<sup>76</sup>

**Conclusion**

Inuit are an Indigenous peoples whose homelands stretch across four countries. Cancer remains a substantial health burden for Inuit populations, and despite the different ways that each health system has adapted to providing health care for this population, geographical and cultural barriers to radiotherapy access and use persist in all Inuit regions. The barriers to access might apply to various pathologies and associated treatment options beyond cancer and radiotherapy. Therefore, the effect of any proposed solutions for radiotherapy would be most pronounced if they were adopted as a component of a larger initiative to improve overall health among circumpolar Inuit communities.

Moving forward, the need for radiation oncologists to capitalise on the strengths that already exist in their own regions is important. Where possible, established telemedicine programmes should be used to improve geographical access to radiation oncology (panel). A model of health service delivery that incorporates visiting specialists, or the establishment of local specialists should also be strongly considered. In regions where telemedicine or visiting specialists are not routinely used or feasible, alternative online platforms, such as eConsultations, should be implemented to improve patient and provider access to radiation oncology not only for routine appointments, but to also initiate a

### Search strategy and selection criteria

For this Review, we searched PubMed using a combination of keywords related to "Inuit", "Circumpolar", "Cancer", "Access", and "Radiotherapy". Our search covered articles published in English on any date up to Feb 12, 2019. We also searched the grey literature for relevant documents and technical reports produced by government agencies and not-for-profit organisations in any language. Data from these searches were supplemented by discussions with key informants in each of the circumpolar regions. Types of informants targeted for this Review were radiation oncologists and other health-care experts familiar with delivering health services for circumpolar Inuit, including nurses, radiation therapists, and government officials. Sample questions included those that addressed payment models for circumpolar Inuit patients, radiotherapy services (number of radiotherapy centres and their locations, travel and referral pathways, available logistic and cultural services), and any challenges or successes experienced in delivering radiotherapy to this population.

strong dialogue between local providers and specialists. Such technology can also be used to deliver online educational sessions in oncology for providers of any level among the Inuit regions. The implementation of any telemedicine also necessitates a strong electronic medical record. Additionally, increased cultural competency training and availability of language-specific radiotherapy resources should be provided at centres that provide care to Inuit patients, and elective rotations among circumpolar communities in oncological specialties should be developed to promote awareness of the issues faced by these patients. To help overcome cultural and geographical challenges that can result in treatment delays, reducing treatment times through hypofractionation should be considered among this population if possible. Finally, more research is urgently needed to understand the effect of access to radiotherapy on use and outcomes, in addition to exploring Inuit patients' experience with cancer treatment. Clinical databases to monitor and evaluate cancer treatments across the circumpolar north should be established as a first step in providing such data.

No single solution will be applicable to all regions, and the successful models of care identified in this Review need to be tailored to the specific geographical, cultural, and economic constraints of each region. Measuring the cost-benefit ratio of any solution is important, which can be assessed through local pilot projects before considering scale-up to implementation at the regional or territorial level. In addition, many of the barriers faced by circumpolar Inuit populations are shared by many circumpolar residents, rural, and Indigenous populations, although the combined geographical remoteness and cultural needs of circumpolar Inuit populations might result in unique challenges.

Therefore, to implement sustainable and effective interventions to improve access, including Inuit rights-holders in all processes including research, priority setting, and policy and decision making is vital. Finally, although providers have traditionally and rightfully worked within their own borders to improve access to radiotherapy, a joint effort among circumpolar neighbours is needed to better understand the effect of radiotherapy access on use and outcomes, Inuit patient experiences, and to develop innovative solutions.

### Contributors

JC contributed to development, background research, writing, figures, and editing of this Review. JF, MCherk, MChern, CG, MB, and BS contributed to development, interpretation, and editing. All authors reviewed and modified the draft version.

### Declaration of interests

JF reports grants from Varian Medical Systems, outside the submitted work. BS reports grants from Varian Medical Systems, and grants and personal fees from ViewRay, outside the submitted work. CG, JC, MB, MCherk, and MChern declare no competing interests.

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