FEATURE

Delivering radiation oncology services closer to home: a tale of two regional clinics

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ABSTRACT

The effective delivery of radiation oncology services in the community oncology setting is part of the modern "closer to home" therapeutic paradigm, but remains challenging.[1,2,3,4] In Alberta, the establishment of radiation therapy (RT) facilities in smaller communities was part of the "radiation treatment corridor" strategically envisioned a decade prior to the opening of the first of these 3 centres in Lethbridge in the summer of 2010.[5,6] Prince Edward Island (PEI), saw a similar dramatic expansion of cancer services to assure timely delivery of radiation therapy on the Island as part of a wait times initiative. The culmination of a decade of preparation and planning in PEI ultimately led to the transformation from an RT program that was mainly palliative, to a modern comprehensive provincial radiation service. In both Lethbridge and PEI, transformation involved considerable work in service design, and workforce and equipment planning.[5,6] Exchanges and learning with other small radiation centres in Canada was vital in helping to formulate and implement these strategic processes. Connections with tertiary care centres enabled these smaller centres to formulate and apply quality control elements using existing guidelines, provide academic development, and participate in clinical trials, to the benefit of both patient and medical communities. This article summarizes and contrasts the functioning of the Lethbridge and PEI programs, providing lessons and models for other regional centres looking to develop a community radiation oncology service.

Keywords: radiation therapy delivery models, decentralized radiation therapy services, radiation therapy distribution, community radiation oncology, barriers to radiation therapy, optimization of radiation oncology therapy

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INTRODUCTION

The radiation oncology clinic in Lethbridge was developed as an integral part of the Alberta radiation treatment corridor strategy. Planning for these distributed radiation therapy (RT) centres began in the early 2000s, spearheaded by Dr. Peter Craighead, in response to projected treatment needs.[5,6] The ultimate goal was to provide high-quality RT to cancer patients closer to home, reducing reliance on tertiary care centres in Calgary and Edmonton. The regional centre in Lethbridge opened in 2010, Red Deer in 2013, and the centre in Grande Prairie is due to open in 2019.

In Lethbridge, design and construction began in 2006, with equipment installed and specialized staff hired starting in 2008. Hiring continued after the grand opening of the centre in 2010. The centre's first on-site senior radiation oncologist, Dr. Jane Wilson, undertook much of the organization and coordination of RT services, in advance of the arrival of other specialized staff. Having such an experienced "point person" in situ early on was of significant benefit in addressing operational issues as they arose. In June 2010, the centre treated its first patient, a man with prostate cancer.

In PEI, only palliative and basic radiation treatments were provided prior to the early 2000s, with a cobalt unit supervised by a single radiation oncologist. This service did not meet the needs of islanders, who had to travel to Nova Scotia or New Brunswick for any more complex treatments.

TABLE 1. Modeling estimates for a distributed small radiation centre in PEI, based on 2006 survey

	Distributed model type		
	Basic	**Developed**	**Tertiary***
Access for local patients (%)	80	90	100
RT courses/year	541	704	704
Linear accelerators	1	2	2
CT simulator	1	1	1
Radiation oncologists	3.1	4	3.5
Radiation therapists	10.1	12.3	13.5
Medical physicists	2.1	2.6	2.4

* based on a 2 linear accelerator equivalence
CT: computed tomography; RT: radiation therapy.

Cancer patients faced significant physical, financial, social and emotional stress, as well as longer wait times, and out-of-province radiation services imposed a significant burden on the province's healthcare budget. At the turn of the millennium, PEI initiated a transformation toward a modern comprehensive provincial radiation service.

The province's first linear accelerator was installed in 2003, with a second unit installed in 2009. In 2010, PEI began its implementation of high-precision radiation therapy, including hypofractionation, image-guided radiation therapy and stereotactic ablative treatments. As the province's senior radiation oncologist has specialized postgraduate training in stereotactic body radiation therapy (SBRT), a number of patients from elsewhere in the Maritimes now come to PEI for treatment.

Considerable preparatory work over a decade was required in both Lethbridge and PEI centres prior to opening and expanding radiation services. This included population mapping and forecasting to estimate cancer incidence and type, local and regional population numbers, available medical services, projected growth, and expected use of RT treatments. These efforts served to define workforce and hardware requirements for the newly designed physical spaces. Decisions, whether on hiring or procurement, required specialized knowledge of radiation oncology that was not available within the local host hospital environments.

SERVICE MODEL CONSIDERATIONS FOR PROGRAM IMPLEMENTATION

In order to define the necessary elements of community RT practice, a number of qualitative studies were undertaken in Alberta. Expert interviews were conducted, along with validation surveys of 75 radiation oncology staff members in Calgary. The service delivery model for a small department with 1 or 2 linear accelerators could be either basic (with a focus on palliation) or developed (capable of both radical treatment and palliation).[5,6] In Alberta, Canadian national workforce guidelines, Alberta cancer registry data, census data and radiotherapy utilization estimates were all used to project the human resources required to treat at least 77% of patients. This 77% model was in fact similar to a model used earlier in PEI and Sydney, Nova Scotia.[6]

In PEI, the unique demands on a geographically isolated provincial service required a hybrid between the "developed" and "tertiary" models described in **Table 1**. This service model was justified by the greater number of tumour sites requiring treatment on the island, compared to the more limited range in Lethbridge.

TABLE 2. Human and physical resources in the Lethbridge (Leth) and PEI radiation therapy departments

Workforce						
	2010		**2013**		**2016**	
	Leth	**PEI**	**Leth**	**PEI**	**Leth**	**PEI**
Radiation oncologists	1	2	2	2	2	2
Radiation therapists	7	15.5	10	15.5	8	15.5
Medical physicists	2	4	2	5	2	5
Biomedical engineer	1	1	1	1	1	1
Physics assistant	0	0	1	0	1	1
RT RN	1	1	2	1.5	2	2
Nurse practitioner	0	0.5	0	0.5	0	0.5
GPO clinical associate	0	0.6	0	0.9	0	1.2
RT clerks	1	2.5	2	2.5	2	2.5
RT administrative assistant	1	0.5	2	0.5	1	0.5
RT care plan coordinator	0	1	0	1	0	1
Physical resources						
	2010		**2013**		**2016**	
Linear accelerators*	2	2	2	2	2	2
CT simulator	1	1	1	1	1	1
RT consult/exam rooms	2	4 + ENT	2	4 + ENT	2	4 + ENT
RT medical daycare beds	2	2	2	2	2	2
Medical physics lab	1	1	1	1	1	1
RT electronics lab	1	1	1	1	1	1
Video-linked rooms	3	0.5	3	0.5	3	0.5

*6/15 megavolts (Lethbridge), 6/18 megavolts (PEI): electron; image-guided radiation therapy (IGRT); intensity-modulated radiation therapy (IMRT); kV cone-beam computed tomography (kV-CBCT); stereotactic body radiation therapy (SBRT); three-dimensional conformal radiotherapy (3DCRT); volumetric modulated arc therapy (VMAT).
CT: computed tomography; ENT: ear, nose and throat; GPO: general practitioner in oncology; RN: registered nurse; RT: radiation therapy.

Connectedness with tertiary radiation centres (Lethbridge with Calgary and Edmonton; PEI with Dalhousie in Nova Scotia) was a vital and necessary contributor to community program success. Provincial tumour-specific radiation guidelines were developed to ensure high-quality care.[7] As much as possible, electronic medical records and treatment planning platforms were integrated with those of the tertiary centres.[8,9] Both sites actively pursued linkages with all programs involving the local host hospital and medical community. They also recognized the importance of creating an environment that would be perceived as attractive, to facilitate the recruitment and retention of staff, especially since none of these specialized individuals would likely be from the local area initially. Quality control assessments using national and provincial professional standards were applied, including those of the Canadian Association of Radiation Oncology (CARO) and the Canadian Partnership for Quality Radiotherapy (CPQR).[10,11]

Access to academic opportunities and participation in clinical trials has been problematic in smaller radiation centres.[12,13] However, in Lethbridge and PEI, close linkages with the tertiary centres made it possible to integrate clinical trial activity into the new radiation oncology resources.

HOW THE COMMUNITY RADIATION PROGRAMS IN LETHBRIDGE AND PEI ACTUALLY FUNCTION

In the case of Lethbridge, preliminary surveys showed that staff significantly preferred a "developed" model of radiation centre.[5,6] In practice, the current functioning and workforce in Lethbridge reflect elements of both the basic and developed model. In contrast, the PEI centre has evolved to reflect elements of both developed and tertiary models (**Table 2** on page 7).

In both centres, the nature of radiation treatments provided to local and regional patients also reflects a blend of the various models. Statistics on radiation oncology service delivery reflect the expertise, treatment complexity and available medical services in each of the local communities (**Figure 1** and **Table 3**).

FUNCTIONAL COMPARISONS WITH OTHER SMALLER RADIOTHERAPY DEPARTMENTS IN CANADA

In term of overall function, the Lethbridge community radiation therapy program is similar to a number of other smaller radiation centres in Canada (**Table 4**).[14] The principal tumour sites treated in Lethbridge and PEI are breast, genitourinary, gastrointestinal, lung, SBRT lung and palliative. PEI also provides radical radiation for head and neck, lymphoma, skin, central nervous system, gynecology, sarcoma and SBRT for oligometastases. In Lethbridge, treatment of similarly specialized areas is undertaken periodically on a shared-care basis with a Calgary-based radiation oncology subspecialist.

Due to unique geographical issues and patient needs, the PEI radiation program offers additional specialized services, such as radioactive iodine ablation for thyroid cancer, and the PEI radiation oncologist runs an advanced community ear, nose and throat (ENT) radiation oncology practice, in collaboration with a visiting ENT specialist surgeon from the tertiary centre.

TABLE 3. Radiotherapy planning and treatment metrics in Lethbridge/PEI 2013-2016

	2013		2016	
	Leth	PEI	Leth	PEI
RT courses	410	443	490	500
RT sessions	6010	9119	6078	8655
Average sessions per course	14.8	20.6	12.4	17.3
RTT to 1st fraction (% < benchmark)	100	97	89.1	94
Benchmark (weeks)	2.8	4	1	4
RTT to 1st fraction (days to 90th percentile)	4.9	23.1	6.2	25.9

RT: radiation therapy; RTT: ready-to-treat date.

DISCUSSION

The Canadian strategy for cancer control predicts the incidence of cancer will increase 70% over the next 15 years.[15] Recently, there has been a major shift in the delivery of cancer care, with an emphasis on patient-centred care provided closer to home, rather than in the tertiary facilities of major urban centres. This means that a significant portion of treatments previously delivered in tertiary centres are now being administered in smaller or community-based

TABLE 4. Functional comparison between the two community oncology radiation departments

Functional comparison	Lethbridge	PEI
Radiation oncologists (RO)	2	2
Hours/RO/week	46	Variable
Half day clinics/RO/week	8	8
Teaching hours/RO/week	2	2-3
Administrative hours/RO/week	3	4-6
Most responsible provider (MRP) inpatient coverage	no	no
Clinical trials	yes	yes
Clinical conferences/RO/week	8	Variable
Academic conferences/RO/year	4	2-4
Academic presentations/RO/year	4	2-5
University medical school appointment	yes	yes

MRP: most responsible provider; RO: radiation oncologist.

cancer clinics. In some provincial jurisdictions, more than 50% of all cancer chemotherapy is now delivered in the community setting (in Alberta, the figure is 30%).[15]

It has been estimated that between 50% and 60% of all cancer patients may require radiation therapy at some point during the evolution of their illness.[1,2,3,4] However, in 2010, it was noted that only 33% of those diagnosed with cancer in Ontario, and 31% nationally, actually received a course of RT within 2 years of diagnosis.[4] While patient variables such as socioeconomic context, and provider variables such as referral rates and understanding of the potential benefits of RT, all play a role, geographic distance to treatment, as well as the characteristics of RT centres (including their distribution), are also major contributors to treatment gaps.[3,4,6] In this regard, rural patients may be even more heavily penalized. For instance, a BC study involving breast cancer patients noted a 12% lower RT utilization rate for rural patients versus their urban counterparts.[16]

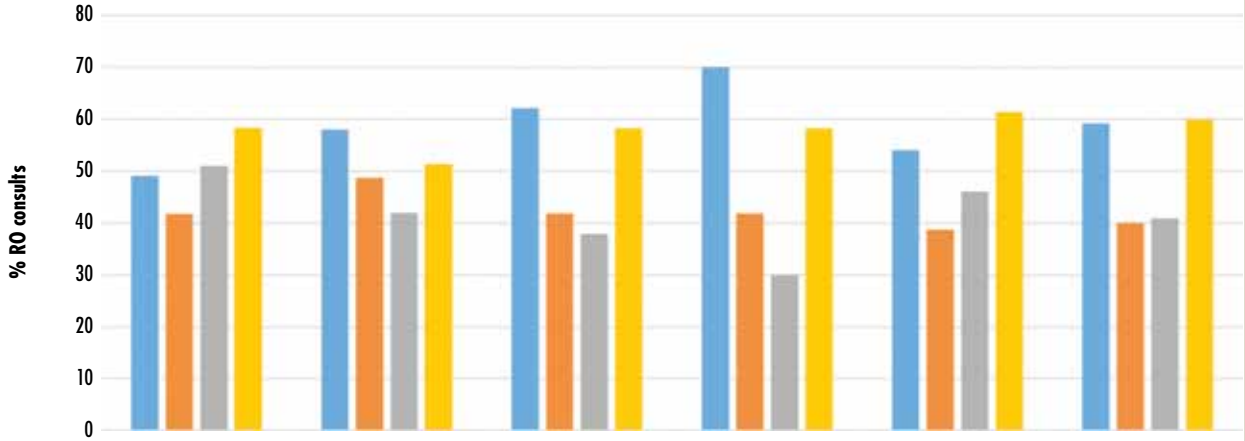
Compared to chemotherapy, the dissemination of RT services into the community has historically been slow.[1,2,5,6] Radiation oncologists have tended to work in larger group practices, which can provide them an opportunity to develop subspecialized expertise in specific types of cancer.[4,5,12] A centralized system may also be more fiscally efficient, by preventing unnecessary duplication of expensive facilities. Indeed, it has been suggested that there might be a significant cost penalty associated with the operation of smaller comprehensive radiation centres.[1,2,4]

However, more comprehensive societal perspectives on cost, which include patient travel costs, indicate that traveling more than 100 km for treatment makes the centralized delivery model for RT the most expensive.[2] In addition, provincial jurisdictions such as PEI that make significant use of interprovincial health funding agreements find that the costs of off-island treatment per patient escalate dramatically.

Recent attention has also focused on other challenges faced by patients who have to temporarily relocate away from their homes to receive appropriate RT treatments over several weeks. These include financial constraints, stress associated with travel, and time spent away from local support systems.[3,16] Indeed, it has been suggested that travel distances longer than 100 km or 90 minutes driving time are associated not just with decreased RT utilization, but also with inferior clinical outcomes, including decreased post-therapy survival.[3,6,16]

Multiple strategies have been proposed for determining the ideal geographic location for RT centres in order to optimize access.[1,2,4] In the case of Alberta, modeling based on geographic distribution of demand suggested that community-based centres at 3 locations along the so-called "radiation corridor" should theoretically result in 82% of Albertans living within a 100-km radius of a radiation treatment facility.[5,6]

FIGURE 1. Radiation oncology (RO) consultation types in Lethbridge/PEI 2011–2016



	2011	2012	2013	2014	2015	2016
Leth % palliative	48	59	62.1	70	54	59.1
PEI % palliative	41.7	48.7	41.8	41.8	38.7	40
Leth % cure	51	42	37.9	30	46	40.9
PEI % cure	58.3	51.3	58.2	58.2	61.3	60

Alberta planners also formulated the 3 service delivery models mentioned earlier: a tertiary model, where 100% of patients receive treatment locally; a basic model, with palliative RT as the main focus, with some radical treatments (80% able to receive treatment locally); and a developed model, where most of both radical and palliative treatment (90%) is delivered locally.[5,6] Planners also identified 3 concerns in a devolved radiotherapy system: the need for transparent connections between the tertiary and smaller centres in order to maintain quality; a balance in the dynamic tension between complexity of treatment and quality of care; and a need to assure staff training and retention.

In both PEI and Lethbridge, a major factor in satisfying these requirements has been the establishment of treatment planning systems, electronic medical records, and treatment standards that are as consistent as feasible throughout the network. Studies have shown that when individual RT centres are linked by appropriate databases and implement quality assurance/quality improvement initiatives using accreditation criteria, there is no significant difference in performance between smaller and larger centres.[17,18,19] This has also proven true for more complex treatments, such as SBRT, where a team-based approach and standardized guidelines for dose fractionation and normal tissue protection has translated into therapy in the community RT setting that is just as effective as in tertiary centres.[19] In Alberta and PEI, the ongoing review of radiation oncology practice and program performance in meeting key quality indicators established by the CPQR further ensures consistent quality in radiation services.[13]

High-quality professional standards are obviously a priority in a small radiation centre. Videoconferencing allows for the exchange of images relevant to the clinical planning process.[20] Teleconferencing for educational purposes may also be utilized in RT, as it is in other medical disciplines. For instance, in Lethbridge, case management conferences are video-linked with the appropriate subspecialty tumour site in Calgary on a weekly basis, allowing input from subspecialty RT oncologists. Weekly treatment planning quality assurance rounds can also be video-linked with the tertiary centre for each tumour group site.[20] The challenge is less in assuring such resources, than in RT centre staff finding time to participate in them all.

A number of studies have shown that lack of knowledge on the part of primary care physicians regarding the potential benefits of RT represents a significant barrier to the appropriate utilization of these services.[3,4,21] For instance, one Alberta study showed that community physicians significantly underestimated both the degree of potential benefit and the duration of palliative relief offered by radiation therapy for bony metastatic disease.[21] Having radiation oncologists directly embedded locally allows them to play a key role in educating the medical community regarding optimal cancer care.[12,18] Periodic surgical and pathology rounds, weekly cancer clinic triage, case reviews and annual community conferences may also be arranged.[12]

Ongoing education opportunities become available in the smaller RT centres, and teaching and mentoring of medical students and residents helps to fulfill the requirements associated with academic appointments at the University of Calgary and Dalhousie University Faculties of Medicine. At the University of Calgary, each radiation oncology resident must now undertake a "rural" rotation in a smaller radiation centre. Also in Alberta, annual tumour team meetings, to review new developments in the literature and update provincial treatment guidelines, bring provincial oncologists together in a face-to-face setting. Every effort is made to include community oncology representation in provincial working groups and committees. Participation in these meetings is usually by video or audio conference, as attendees are often scattered in different geographic locations around the province. In Alberta, annual professional practice reviews also take place with the head of radiation oncology.

While particularly challenging in the current climate of fiscal restraint, incorporating clinical trials into small radiation therapy centres is desirable.[6,12] A small centre must carefully plan how to best use its workforce and equipment, and optimize links to the tertiary centre. In Lethbridge, this has been accomplished by partnering with Calgary and Red Deer to open an accelerated partial breast irradiation study. The necessary work was shared between senior investigators and the clinical trials unit in Calgary. Patient accrual, treatment, followup and data collection takes place locally in Lethbridge. Data are then entered into a secure network database to be analyzed at the tertiary site. Such methods for participating in clinical trials will help to determine which future trials are likely to be successful in smaller RT centres. Local success with this particular trial represents a "proof of concept" that academic pursuits are possible in smaller RT centres.

CONCLUSIONS

The ultimate goal of a devolved RT system should be to provide cost-effective, safe and optimal care for cancer patients as close to home as possible.[1,4,5,12] Such a service can minimize patient inconvenience and streamline the RT referral process. An additional benefit is in limiting the patient load in upstream tertiary centres, allowing for greater focus on research, and establishment and support for provincial standards.[1,12] A devolved RT program also assures on-site radiation oncology presence in the local community, providing opportunities to educate primary care physicians on the important role of RT in treatment and palliation.[3,21]

RT therapy requires efficient planning, verification, monitoring, quality control and ongoing improvement in all aspects of service delivery, including organizational and technical matters.[2,6,12] Technology is now available to ensure that quality radiotherapy is delivered at remote locations.[13,19,20] This article illustrates that in both Lethbridge and PEI, community RT programs can meet all of these requirements, in addition to bringing treatment closer to home and increasing patient satisfaction. The collective experience of existing distributed centres may serve as a model for others contemplating the establishment of similar programs.

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