

PET Scanning in Canada

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PET scanning is used mostly for pre-treatment staging of selective malignancies and for diagnosing recurrence, especially when there is difficulty distinguishing between recurrence and scar tissue. Researchers are evaluating other possible indications for PET scanning with fluoro-deoxyglucose (FDG) including early assessment of response to non-surgical treatments, allowing for individualization of treatment with reduced morbidity and improved overall control.

The infrastructure required to support PET programs includes clinical imaging capabilities to support image processing and interpretation, appropriate quality control and quality assurance systems, radiation safety expertise and infrastructure as well as trained physicians and technologists. Fluorine-18 has a half life of 108 minutes and is produced in a cyclotron. A PET scanning facility must be able to have access to a cyclotron facility that produces the 18F-FDG. While 18F-FDG can be shipped over large distances, a rule of thumb is that shipping times should be less than three half lives (approximately five hours) to allow clinically useful quantities to be available upon delivery.

Health Canada's regulations regarding the manufacturing and supply of 18F-FDG changed in 2003. Until then, a small number of centres in Canada offered clinical PET services but new regulations resulted in Health Canada issuing a "cease and desist" order to centres manufacturing 18-FDG for routine clinical service. Each manufacturer must now prepare and file a New Drug Submission (NDS) for 18F-FDG. This is a time-consuming and costly process. Two centres have filed and one has been accepted. In the meantime, all 18F-FDG manufactured and supplied in Canada, for what is in fact mostly routine clinical service use, has to be performed under a Clinical Trials Application (CTA). Most PET facilities have developed clinical trials allowing 18F-FDG to be administered under a CTA agreement to patients, for most of the indications approved in other countries (see Table 1). Table 2 shows indications approved under the CTA agreement in Alberta; the list is similar in all provinces where routine clinical PET scanning is funded.

Publicly Funded PET Scanning

Routine access to PET services is available under the above arrangement for patients in all provinces except

HOW IT WORKS

The metabolism of many cancers differs from that of normal tissues with respect to their relative use of glucose, resulting in these cancers taking up and metabolizing more glucose than surrounding non-cancerous tissues. Fluorodeoxyglucose (FDG) has a very similar molecular size and shape to glucose and follows the same transportation and metabolic pathway into the cell, up to a point where one of its metabolites is not further metabolized and accumulates within the cell. FDG radio-labeled with Fluorine-18 (18F-FDG) is the radiopharmaceutical used most frequently for detecting cancer as it is preferentially accumulated in malignant tissues and the radiation emitted from this isotope can be detected and recorded, resulting in a PET image. PET images can be acquired simultaneously with CT images to produce a PET/CT scan providing more precise anatomical localization of the FDG avid tissues.

TABLE 1 **Approved International Indications for Clinical Use of 18F-FDG**

	USA	EU	Australia
Brain			E
Breast	S R M		
Colo-rectal	D S R	E M	S R
Head and Neck	D S R	A	
Lung	D S R	D A E	E S
Lymphoma	C D S R	A D	
Melanoma	D S R	A	E
Thyroid	R		
Cervix			S
Esophagus	D S R		S
Ovary			E
Stomach			S

A – Assessment
 C – Characterization
 D – Diagnosis
 R – Re-staging
 E – Evaluation
 M – Monitoring
 S – Staging

TABLE 2 ALBERTA INDICATIONS

PRIMARY CANCER	INDICATION
Lung	- Diagnosis and staging - Solitary pulmonary nodule
Lymphoma	- CT post-treatment
Gynecology	- Staging after occurrence - Assess surgical respectability
Rectal/Colorectal	- Persistent elevated CEA - Staging after recurrence
Thyroid	- Thyroid ca with elevated thyroglobulin, post treatment
Breast	- Local regional recurrence
Brain	- Recurrence versus radiationnecrosis
Melanoma	- Staging after recurrence - Assess surgical resectibility
Esophagus	- Staging
Head and Neck	- Staging - Staging after recurrence - Assess for surgery - Monitoring
Indeterminate Liver Lesions	- All primaries
Germ Cell	- Diagnosis of recurrence - Differentiation of scar from recurrence
Sarcomas	- Diagnosis of recurrence - Differentiation of scar from recurrence
Unknown Primary	- Staging/diagnosis
Epilepsy	- Diagnosis of recurrence - Refractory; potential surgical candidate; peds and adult

Only six scans are funded for every 100,000 people in Ontario, a disconcerting 30 times lower than Quebec and the lowest rate in Canada

Ontario. Access is variable because not all provinces have PET facilities and must arrange for patients to be scanned out of province, and funding levels vary from province to province. However, we have no evidence that funding restrictions prevent patients from obtaining a PET scan in provinces that do not have scanning facilities. To our knowledge scans have been funded when an oncologist has requested a scan and the patient has been willing to travel.

Across Canada 18 centers are performing publicly funded scans and four additional centers are performing privately funded scans. The status of publicly funded routine PET scanning in Canada is shown in Table 3. The availability of publicly funded cyclotron and FDG manufacturing sites in Canada is shown in Table 4.

Access to publicly funded PET scanning for cancer patients in Ontario is limited to patients who are candidates for five clinical trials run through the Ontario Clinical Oncology Group (OCOG) and restricted, individually-approved access through the Ontario PET Registry Program (OPRP). The diagnoses included in the five trials are head and neck cancer (one trial), breast cancer (one trial), colorectal cancer (one trial) and non-small cell lung cancer (two trials). Funding is available to scan approximately 1,500 patients over a two year period. This restriction results in only six scans being funded for every 100,000 people in Ontario. This is a disconcerting 30 times fewer than the number of scans funded in Quebec and is the lowest rate in Canada.

TABLE 3 AVAILABILITY OF PUBLICLY FUNDED CLINICAL PET SCANNING IN CANADA, DECEMBER 2006

PROVINCE	SCANNING FACILITIES	NUMBER OF SCANS FUNDED/YEAR	FUNDED SCANS/PER 100,000 POPULATION/YEAR
British Columbia ¹	1	2,000	47
Alberta ²	3	6,000	178
Saskatchewan ³	0	130	15
Manitoba ⁴	1	900	77
Ontario ^{5,6}	5	750	6
Quebec ⁷	7	16,000 ^b	209
New Brunswick	1 ^a	300	40
PEI	0	20	15
Nova Scotia ⁸	0 ^c	60	6.5
Newfoundland ⁹	0 ^d	50	10

a - 1 additional planned within two years with funding for a total of 400 scans per year

b - To be increased to 23000 with additional scanners opening in 2007

c - scanner opening in 2007 with funding for 1500 patients annually

d - scanner planned for 2009

TABLE 4 **PUBLICLY FUNDED CYCLOTRON AND FDG MANUFACTURING SITES IN CANADA, DECEMBER 2006**

PROVINCE	CYCLOTRONS	APPROXIMATE YEAR OF CONSTRUCTION	RESEARCH AND/OR CLINICAL PRODUCTION
British Columbia ¹	1 (1)	1980 2007 (anticipated)	TRIUMF mainly R R & C
Alberta ²	1	2002	R & C
Saskatchewan ³	0		
Manitoba ⁴	(1)	2008 (anticipated)	
Ontario ^{5,6}	3	1980, 2001, 1990	R
Quebec ⁷	2	1980, 2000	R & C
New Brunswick	0		
PEI	0		
Nova Scotia ⁸	1	2008 (anticipated)	R & C
Newfoundland ⁹	0		

Privately Funded PET Scanning

There are four private PET scanning facilities in Canada. One private scanning facility is in Vancouver, British Columbia where the price per scan ranges from \$2,100 to \$2,850 and a wide variety of clinical indications are accepted. One facility is available in Mississauga, Ontario. The range of indications accepted is wider than those provided at publicly expensed facilities in Ontario. The cost of entry into the trial necessary to obtain the scan is \$2,358. Two private PET facilities exist in Quebec scanning 400 patients per year.

Conclusions

Cancer patients' access to PET scanning varies greatly across Canada. Residents of Quebec have the best access and despite the fact that Ontario is well supplied with scanning facilities, access to PET scanning is restricted in Ontario. Saskatchewan, PEI, Nova Scotia and Newfoundland have no facilities and their residents must travel out of province to obtain a scan.

World wide, the major use of PET scanning is in oncology. Ontario, in contrast to the rest of Canada and indeed the rest of the developed world has a philosophy that results in rationing PET scans for cancer patients. Not only are current cancer patients disadvantaged through lack of standard diagnostic scanning but future cancer patients in Ontario may miss out on the opportunity to benefit from the next phase of PET development and research. Without the infrastructure, Ontario could miss opportunities to investigate variable drug uptake and metabolism within cancers, and the ability to use this form of imaging as a predictive assay.

Furthermore, the training of future medical specialists in Ontario is now being compromised. Residents in Nuclear Medicine in particular require experience in the interpretation of PET scans, but cannot obtain sufficient

experience in Ontario due to the small number of scans being performed. These residents must travel out of province and even out of country to gain the necessary experience.

Recommendation

Access to PET scanning in Canada should be equitable, regardless of where in Canada one lives. The level of access in Quebec should be achieved elsewhere in Canada within the next five years.

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