CADTH

Canadian Medical Imaging Inventory Service Report

Publicly Funded PET-CT Indications: A Pan-Canadian Comparison

Context

PET-CT is a non-invasive, nuclear medicine diagnostic technology that permits the diagnostic measurement of physiological and biochemical processes in the body.[1] PET-CT is considered essential to oncology for disease staging, monitoring response to treatment, therapeutic planning, and detecting recurrence.[1] Particularly when implemented at the beginning of the diagnostic pathway, information derived from PET-CT can lead to cost savings by avoiding unnecessary imaging tests, biopsies, or treatments.[1] PET-CT is also used for the assessment of some non-oncological conditions, mainly in the clinical fields of cardiology, neurology, and infectious disease.[2] In Canada, 80% of all PET-CT use is for oncology exams.[3]

PET has experienced growth in Canada since it was introduced in the early 2000s.[4] By 2005, there were approximately 10 PET-CT units in Canada, 3 of which were available for clinical use, with the others operating under research protocols for clinical trials.[5] Almost 15 years later, the number of units has more than quadrupled to 57 and all but 1 province has a minimum of 1 unit.[3] When the number of PET-CT units per population for Canada is compared to those reported by other countries via the Organisation for Economic Co-operation and Development (OECD), Canada appears in the lower-third of the reported numbers.[3]

The volume of PET-CT exams has grown in the last 20 years. From 2000 to 2005, a total of 5,000 PET exams were performed across Canada.[5] This expanded to 42,620 exams in 2009[1] and 76,824 exams in 2015,[6] to 90,530 exams in 2017[7] and 125, 775 exams for the period 2019–2020. When compared with OECD countries, Canada ranks below the mid-point for exams per population.

Referral privileges to PET-CT in all provinces extends to clinical specialists, although some provinces restrict ordering privileges to specific types of specialists, such as oncologists and surgeons. Family physicians and general practitioners can order PET-CT exams in 2 provinces, and 1 province grants these privileges to nurse practictioners.[3]

Objective

This document summarizes the information on publicly funded indications for PET-CT. The key objective is to compare current publicly approved indications for PET-CT in provinces in Canada that have 1 or more PET-CT units.

Methods

The findings of this report are based on responses to a CADTH survey on the clinical uses of PET-CT. Survey respondents were asked to update and complete, according to jurisdictional practices, the table that was later included the 2015 report[8] on publicly funded PET-CT indications. The survey was sent to key informants from provincial government health ministries and medical imaging-related professional bodies in jurisdictions with PET-CT equipment in Canada. Survey data were gathered until March 31, 2021. In addition, a limited literature search was performed.

Results

Surveys were distributed to contacts in all provinces with PET-CT units. Survey responses were received from informants in all provinces with PET-CT capacity: British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, New Brunswick, Newfoundland and Labrador, and Nova Scotia.

Currently, a national approach for the use of PET-CT as a clinical tool has not been adopted; instead, the publicly funded indications for PET-CT vary from province to province. While PET-CT is predominantly funded for oncology, many jurisdictions fund its use, albeit to a lesser extent, for cardiology, neurology, and infectious/inflammatory conditions.

In 4 provinces — Alberta, Manitoba, Quebec, and Newfoundland and Labrador — all PET-CT requisitions are reviewed for clinical approval by a nuclear medicine physician. In Alberta, nuclear medicine physicians prioritize all PET-CT requisitions. In Manitoba and Ontario, indications not shown in Table 1 are considered on a case-by-case basis by members of their provincial PET-CT programs. In Manitoba, this involves a review by a nuclear medicine physician; and in Ontario, a panel of clinical experts (which typically includes a disease specialist, a nuclear medicine physician, and a radiologist) conduct the review.

The use of PET-CT in Quebec is not limited to a specific set of government-approved indications and referral privileges are not restricted to groups of physicians. Instead, referral guidelines developed by the Institut national d'excellence en santé et en services sociaux (INESSS), in collaboration with the medical community in 2017,[9] guide PET-CT practice.

Oncology Indications

The primary use for publicly funded PET-CT is oncology. Overall, there is significant overlap between the provinces on publicly funded cancer indications. The approval for specific indications may differ from province to province, based on specific clinical and treatment scenarios and whether PET-CT is indicated for diagnosis, staging, therapeutic guidance, response to treatment, restaging, or follow-up. This level of detail is not reported here due to variability in the granularity of reporting from province to province.

In oncology, all provinces publicly fund PET-CT — albeit with some variation in coverage — for solitary pulmonary nodules and for some types of lung cancer such as head and neck, esophageal, breast, colorectal, lymphoma, melanoma, thyroid, testicular, and gynecologic. All publicly funded indications are shown in Table 1. In some instances, funding for specific indications are limited to pediatric populations or are evaluated on a case-by-case basis.

Various clinical trials are underway across Canada involving new and emerging PET radiopharmaceuticals. In Alberta, the University of Alberta Hospital in Edmonton has a clinical trial in progress for the F-DOPA PET (fluorine-18-fluoro-dihydroxyphenylalanine) radiopharmaceutical. It is the main Canadian referral centre and it accepts interprovincial transfer patients. As a long established radiopharmaceutical that is approved in many countries,[10] F-DOPA PET is publicly funded in Alberta for neuroblastoma, neuroendocrine tumours, and central nervous system neoplasms. In British Columbia, F-DOPA PET is also being studied for neuroendocrine tumours.[11]

In Ontario,[12] British Columbia,[11] and Alberta, gallium-68 (^{68}Ga)-labelled somatostatin analogues (including ^{68}Ga-DOTA-TATE (^{68}Ga-1,4,7,10-tetraazacyclododecane-1,4,7,10-tetraacetic acid-tyrosine-3-octreotate) and ^{68}Ga -HA-DOTA-TATE (^{68}Ga-DOTA-3-iodo-Tyr3-octreotate) are funded as part of clinical trials for neuroendocrine tumours. A commercial, Health Canada-pproved ^{68}Ga-labelled somatostatin analogue was released to the Canadian market in April 2020.[13]

Other clinical trials involving new PET radiopharmaceuticals include PSMA (prostate-specific membrane antigen) PET. In British Columbia,[11] Ontario, and Saskatchewan, PSMA PET is being studied as part of clinical trials to determine its accuracy in detecting prostate cancer recurrence and/or remission. A clinical trial is being prepared in Alberta for combining PSMA PET (^{18}F-PSMA-1007) with MRI for initial staging in prostate cancer. As well, a clinical trial is underway in Quebec to determine the utility of PSMA PET-guided radiation therapy.[14]

Table 1: Publicly Funded Oncology Indications by Jurisdiction

Indication	BC	AB	SK	MB	ON	QC[9]	NB	NL	NS
Cancer									
Solitary pulmonary nodule	Y	Y	Y	Y	Y	Y	Y	Y	Y
Lung	Non–small cell	Y	Y	Y	Non–small cell Limited disease small cell Mesothelioma	Y	Y	Y	Y
Head and neck	Y	Y	Y	Y	Y	Y	Y	Y	Y
Esophageal	Y	Y	Y	Y	Y	Y	Y	Y	Y
Breast	Y	Y	Y	Y	Locally advanced: clinical trial	Y[a]	Y	Y	Y
Germ cell tumours	Y	Y	Y	Y	Y	N	N	Y	N
Anal canal	Y	Y	Y	Y	Y	N	N	Y	N
Colorectal	Y	Y	Y	Y	Y	Y	Y	Y	Y
Lymphoma	Y	Y	Y	Y	Y	Y	Y	Y	Y
Melanoma	Y	Y	Y	Y	Y	Y	Y	Y	Y
Myeloma	Y	Y	Y	Y	Y	Y[a]	Y	Y	N
Prostate	PSMA PET: clinical trial	Y PSMA PET	PSMA PET: clinical trial	N	PSMA PET: via Health Canada clinical trial application (multi-site registry)	Y[a]	N	N	N
Thyroid	Y	Y	Y	Y	Y	Y[a]	Y	Y	Y
Testicular	Y	Y	Y	Y	Y	Y	Y	Y	N
Gynecologic	Y	Y	Y	Y	Y	Y	Y	Y	N
Occult	Y	Y	Y	Y	Y	Y	N	Y	N
Sarcoma	Y	Y	Y	Y	Y	Y	Y	Y	N

Indication	BC	AB	SK	MB	ON	QC[9]	NB	NL	NS
Brain	Y	Y Includes F-DOPA PET for radionecrosis vs. recurrence	N	Y	Pediatric only	Y	Y	Y	N
Neuroblastoma	Pediatric only	F-DOPA PET	N	Y	Pediatric only	N	N	Pediatric only	N
Pancreatic	Case by case	Y	Y	Y	Case by case	Y[a]	Y	Y	Y
Penile	Case by case	Y	Y	Y	Case by case	Y	N	Case by case	N
Neuroendocrine	Case by case	Y Includes F-DOPA PET and ^{68}Ga-DOTA-TATE PET clinical trials	Y	Y	^{68}Ga-DOTA-TATE PET	Y	Y	Case by case	N
Musculoskeletal	Case by case	Y	Y	Y	Case by case	N	Y	Case by case	N
Gall bladder	Case by case	Y	Y	Y	Case by case	N	Y	Y	N
Gastrointestinal stromal	Y	Y	Y	Y	Case by case	Y	N	Y	N
Gastric	Case by case	Y	Y	Y	Case by case	Y[a]	Y	Y	N
Kidney	Case by case	Y	Y	Y	Pediatric only	Y[a]	Y	Case by case	N
Liver	Case by case	Y (Includes post-Y-90 microsphere selective radioemboliz-ation PET)	Y	Y	Pediatric only	N	N	Case by case	N
Bladder	Case by case	Y	Y	Y	Muscle invasion: clinical trial	Y[a]	N	Case by case	N
Other	Case by case	Case by case	Y[b]	Case by case	Case by case	Y	N	Case by case	Case by case

AB = Alberta; BC = British Columbia; F-DOPA PET = fluorine-18-fluoro-dihydroxyphenylalanine; MB = Manitoba; NB = New Brunswick; NL = Newfoundland and Labrador; NS = Nova Scotia; ON = Ontario; QC = Quebec; SASK = Saskatchewan; PSMA = prostate-specific membrane antigen; ^{68}Ga-DOTA-TATE = gallium-68-1,4,7,10-tetraazacyclododecane-1,4,7,10-tetraacetic acid-tyrosine-3-octreotate; N = No; vs. = versus; Y = Yes; Y90 = Yttrium 90.

[b] Upon discussion with a nuclear medicine physician.

[a] In certain circumstances.

Non-oncological Indications

Non-oncologic indications, as shown in Table 2, are broken down into 3 main categories: cardiology, neurology, and inflammatory/infectious conditions. Overall, there is a limited alignment in publicly funded non-oncological indications in all provinces, with the exception of cardiac sarcoidosis, which is publicly funded, with some restrictions, in all provinces. For all other indications, public funding is patchy across the country.

In Alberta, F-DOPA PET is publicly funded for the evaluation of the following indications:

- pediatric endocrinology: congenital hyperinsulinism — which determines surgical versus medical management of this condition
- neurology: movement disorders and Lewy body dementia.

Rubidium 82 (^{82}Rb) is used internationally as a clinical PET-CT myocardial perfusion imaging radiopharmaceutical.[15] A key advantage of ^{82}Rb is that it provides concurrent quantification of myocardial blood flow to verify the adequacy of stress response.[16] A Health Canada-approved commercial generator for ^{82}Rb with an associated elution system has been marketed since 2017.[17] Three provinces (Alberta, Ontario, and Quebec) publicly fund the clinical use of ^{82}Rb for myocardial perfusion imaging.

Since 2017, florabetaben has been the only Health Canada-approved and marketed radiopharmaceutical for beta-amyloid plaque brain PET-CT imaging in dementia assessment. While this is publicly funded in Alberta, logistical limitations (for example, decay and expiration in the radiopharmaceutical due to issues with air shipment from the production facility in Toronto, Ontario) have thus far precluded routine clinical usage.

Table 2: Non-oncological Publicly Funded Indications by Jurisdiction

Indication	BC	AB	SK	MB	ON	QC	NB	NL	NS
Cardiac									
Myocardial viability assessment	N	Y	N	N	Y	Y[a]	N	Y	N
Myocardial perfusion assessment	N	Y ^{82}Rb-PET	N	N	Rb-PET	Y	N	N	N
Sarcoidosis	Case by case	Y	Y	Y	Y	Y	Y	Y	Y
Other	N	Infection (e.g., cardiac device, prosthetic valve infection, vascular graft infection) Intracardiac tumour vs. bland thrombus Pericarditis, epipericarditis	N	NR	Case by case	Cardiac tumours; cardiac device and prosthetic valve infection,[a] septic embolism, vascular graft infection,[a] large-vessel vasculitis[a]	NR	Case by case	NR
Neurology									
Refractory seizure	N	Y	Y	Y	Y	Y[a]	N	N	Y
Radionecrosis	N	F-DOPA-PET	N	Y	Case by case	Y	Y	Y	N
Dementia	Case by case	Y	Y	Y	Case by case	Y[a]	N	Y	Y
Other	N	Movement disorders,[1] neuroinflammatory	Upon discussion with a nuclear medicine physician	NR	Case by case	Parkinson-like motor disorder[a]	N	Case by case	N
Inflammatory/Infections									
Lymphadenopathy	N	Y	Y	N	Case by case	N	N	N	N
Inflammatory	N	Y sarcoidosis, large-vessel vasculitis, polymyalgia rheumatica	Y Giant cell arteritis, vasculitis, non-cardiac sarcoidosis	N	Case by case	Sarcoidosis,[a] large-vessel vasculitis[a]	N	Case by case	N

Indication	BC	AB	SK	MB	ON	QC	NB	NL	NS
Infection	N	Hydatid disease (echinococcus infection, spine infection, especially hardware), occult source of infection, hardware infection (e.g., spine), extremity infection	Upon discussion with a nuclear medicine physician	Vertebral osteomyelitis, vertebral discitis	Case by case	Osteomyelitis of the axial or peripheral skeleton,[a] fever of unknown origin[a]	N	Case by case	N
Other	N	Case by case, including fever of unknown origin (neoplastic, infectious or inflammatory etiology)	Upon discussion with a nuclear medicine physician	N	Case by case	N	N	Case by case	N

AB = Alberta; BC = British Columbia; FDG PET or F-DOPA-PET depending on the clinical question; F-DOPA-PET = fluoro-dihydroxyphenylalanine-PET; MB = Manitoba; N = No; NB = New Brunswick; NL = Newfoundland and Labrador; NR = not reported; NS = Nova Scotia; ON = Ontario; QC = Quebec; SASK = Saskatchewan; Rb-PET = rubidium-PET; ^{82}RB-PET = rubidium-82 PET; vs. = versus; Y = Yes.

[a] In certain circumstances.

Conclusion

The most common application of PET-CT is in oncology. Eleven different types of cancer are funded across all provinces. PET-CT is also used, to a lesser extent, for cardiac, neurological, and inflammation/infection imaging. There is a limited alignment with coverage across all the provinces for these indications, with the exception of cardiac sarcoidosis, which is publicly funded, with some restrictions, in all provinces.

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