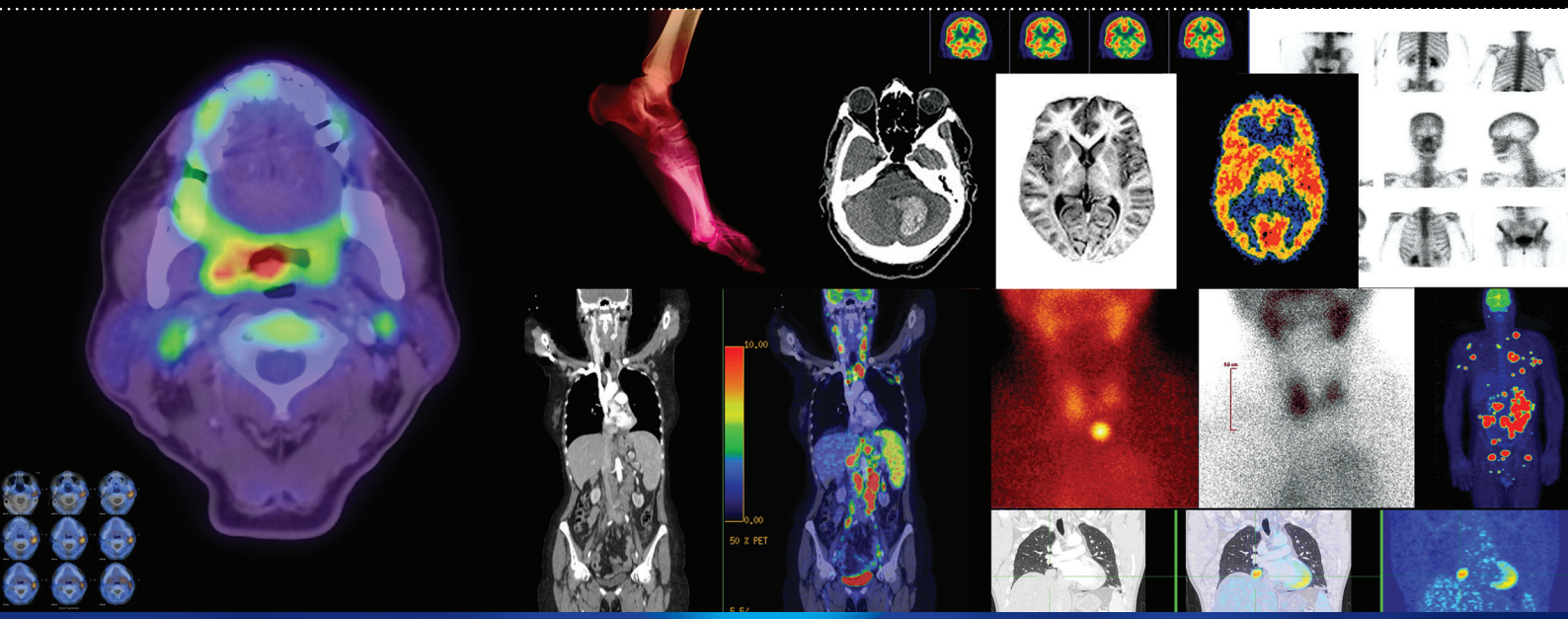
Referrer's Guide to Nuclear Medicine & PET Procedures



Australasian Association of
NUCLEAR MEDICINE
SPECIALISTS

www.aanms.org.au

REFERRER'S GUIDE TO NUCLEAR MEDICINE PROCEDURES INCLUDING POSITRON EMISSION TOMOGRAPHY (PET) PROCEDURES

This information has been prepared by the Australasian Association of Nuclear Medicine Specialists (AANMS) to:

(a) outline the applications of the more commonly performed nuclear medicine and PET procedures,

(b) assist referrers in requesting the most appropriate procedure for a given patient, or

(c) use as a basis for discussion with the nuclear medicine specialist to whom you refer patients.

For any further information about nuclear medicine and PET scans, other clinical problems and less commonly performed procedures, please contact your nuclear medicine specialist colleague.

This information is designed as a reference source for medical practitioners and is intended to supplement information that may be provided by the individual nuclear medicine services to which you refer patients.

Produced by the Australasian Association of Nuclear Medicine Specialists (AANMS) as part of its Quality Nuclear Medicine Program, with assistance from the Australian Department of Health.

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NUCLEAR MEDICINE PROCEDURES

Referral forms may use different terminology for procedures. For example, myocardial perfusion scans are also known as myocardial perfusion stress tests or sometimes listed according to the radiopharmaceutical used (e.g. MIBI, Myoview or Thallium scans). If the procedure you'd like to request seems not to be listed, describe the clinical indication(s) and region of the body that you're interested in and the nuclear medicine specialist will decide the most appropriate scan to undertake in discussion with you.

Times allowed and preparations are intended as a guide only to assist you and your patients when organising appointment times for scans. Please note that approximate time is time from administration of radiopharmaceutical to the end of scanning. For many procedures there is a gap of an hour or more between the administration of the radiopharmaceutical and the scan when patients may be able to go away.

This information is designed as a reference source for medical practitioners and is intended to supplement, not replace, particular patient information provided by individual nuclear medicine services. Your patients should ask the nuclear medicine service to which they are referred for specific information relevant to their procedure. All nuclear medicine services will have information leaflets and the AANMS has produced a general patient information leaflet on nuclear medicine scans. This leaflet is also available online at www.aanms.org.au.

Please note that many procedures will be performed in conjunction with a low-dose CT scan for attenuation correction and anatomical localisation. This CT scan will usually take no more than 10 minutes.

CLINICAL INDICATION	PROCEDURE TO REQUEST	PATIENT PREPARATION	APPROXIMATE TIME
Bone scanning			
Evaluate bony pathologies such as: • bone tumours - primary and secondary • arthritis • osteomyelitis/ infection of the bone • metabolic bone diseases such as Paget's disease • sports injuries • stress fractures, • suspected fractures with normal x-ray • avascular necrosis	Bone scan - whole body or localised	No patient preparation Patients may be asked to drink 3 to 4 glasses of fluid after injection of radiotracer.	Up to 5 hours
Brain/neurological disorders			
Detection and evaluation of cerebral disease including: • dementia • localisation of epileptic foci • brain tumours including suspected recurrence • stroke • suspected brain trauma and brain death • assess cerebral flow reserve	Brain scan (with or without Diamox provocation)	No patient preparation	Up to 1½ hours For some conditions, the scan may be repeated on another day.
CSF studies for: • assessing ventriculo-peritoneal or atrial shunt patency	CSF shunt study	The area around the shunt reservoir may be shaved	2-24 hours
• CSF leaks	CSF leak study	The lumbar puncture site will be prepared according to the standard approach.	2-24 hours
• Hydrocephalus	CSF flow study	The lumbar puncture site will be prepared according to the standard approach.	Up to 48 hours

CLINICAL INDICATION	PROCEDURE TO REQUEST	PATIENT PREPARATION	APPROXIMATE TIME
Cardiac			
Myocardial viability - mostly used where a decision needs to be made as to whether cardiac surgery/revascularisation will provide significant benefit or not	Myocardial viability scan	Nothing to eat or drink (other than water) for 4-6 hours before test	Up to 5 hours A further scan may be performed on the following day - 1-1½ hours.
Assess cardiac function e.g. • in coronary artery disease • cardiomyopathy • before and after chemotherapy	Gated blood pool scan	No patient preparation	1½ hours
Assess myocardial perfusion: • for diagnosis of coronary artery disease and risk stratification • for efficacy post revascularisation (surgical or percutaneous) • for preoperative assessment of patients at risk of ischaemia/ myocardial infarction • in the presence of unexplained arrhythmia Functional studies: Assess significance of: • known coronary artery disease not requiring immediate revascularisation • possible stenotic lesions post revascularisation (surgical or percutaneous) • lesions detected on CT coronary angiography	Myocardial perfusion scan or functional imaging	No products containing caffeine for 24-48 hours before test Nothing to eat or drink (other than water) for 4-6 hours before test Diabetics should contact the nuclear medicine service for special instructions. In consultation with referring doctor, nitrates, beta blockers, calcium antagonists and some erectile dysfunction agents (sildenafil [Viagra], tadalafil [Cialis], vardenafil [Levitra]) may be stopped for 2-3 days before test. Wear comfortable clothing and footwear as patient may need to exercise on a treadmill or stationary bicycle. (Patients unable to exercise will have a pharmacological stress test using dipyridamole, dobutamine or adenosine.)	Up to 5 hours if done on a 1-day protocol. If a 2-day protocol, the initial study may only take 2-3 hours. The patient may be called back on the following day for the second part - 1-1½ hours.

CLINICAL INDICATION	PROCEDURE TO REQUEST	PATIENT PREPARATION	APPROXIMATE TIME
Assess size and location of recent myocardial infarct	Myocardial infarct scan	Performed 2-8 days after an infarct No patient preparation	3-4 hours
Ventricular and atrial septal defects, patent ductus arteriosus (PDA)	(Qp:Qs) cardiac shunt scan	No patient preparation	1-1½ hours
Gall Bladder/Biliary			
Assess biliary tract function including: • acute and chronic cholecystitis • common bile duct obstruction • gall bladder ejection fraction • post-cholecystectomy syndrome	Biliary (function) scan with or without a cholagogue or morphine	Nothing to eat or drink (other than water) for 6-8 hours before test	1-1½ hours Some patients may require a second injection and further scan - allow total of 2½ -3 hours
Gastrointestinal			
Confirm Helicobacter pylori infection/ monitor response to treatment	Carbon-14 urea breath test	Nothing to eat or drink (other than water) for 6-8 hours before test Confirm with nuclear medicine facility but, in general, antibiotics and bismuth-containing drugs should be stopped for 28 days before the test; drugs to treat stomach ulcers should be stopped 48 hours before the test.	30 minutes
Gastric emptying disorders e.g. • diagnosis and follow-up of gastroparesis • rapid gastric emptying/dumping syndrome • investigate epigastric discomfort and bloating • post-gastric surgery assessment	Gastric emptying study	Nothing to eat or drink for 6-8 hours before test	2-3 hours

CLINICAL INDICATION	PROCEDURE TO REQUEST	PATIENT PREPARATION	APPROXIMATE TIME
Investigate function of the colon, assess the severity and type of constipation	Colonic transit study	Preparation instructions vary according to indications. Please contact the nuclear medicine service for specific information.	Day 1 - allow the whole day - radiopharmaceutical taken in the morning as a drink, scan 6 hours later Days 2-5 - repeat scanning - allow 30 minutes each day
Oesophageal motility disorders • achalasia • dysmotility • reflux/aspiration • scleroderma	Oesophageal transit study	Generally, patients will be required to have nothing to eat or drink (other than water) for 4-6 hours before the test.	30 minutes. In some cases delayed views at 24 hours for assessment of aspiration may be acquired
Acute gastrointestinal bleeding	Gastrointestinal bleeding scan	No patient preparation	1½ -2 hours Repeat images may be required 24 hours later
Inflammatory bowel disease	Labelled white blood cell scan	No patient preparation	Up to 5 hours Repeat images may be required the following day.
Meckel's diverticulum	Meckel's scan	Generally, patients will be required to have nothing to eat or drink (other than water) for 4-6 hours before test. Patients may be asked to take an H_2 blocker such as Ranitidine at specified intervals before the test.	1-1½ hours
Salivary gland dysfunction	Salivary scan/study	Generally, no patient preparation	1-1½ hours

CLINICAL INDICATION	PROCEDURE TO REQUEST	PATIENT PREPARATION	APPROXIMATE TIME
Infection/inflammation			
Assess sites of possible infection and inflammation - a means of detecting infection or inflammation in bone, joints and soft tissue as well as inflammation due to other causes, such as inflammatory bowel disease (Ulcerative colitis and Crohn's disease) Occult infection/PUO	Infection scan (Gallium scan, labelled white blood cell scan or Leukoscan depending on indications)	No patient preparation	Up to 6 hours Repeat scan may be required the following day.
Assess bone marrow distribution - supplement a bone scan and/or a Gallium or labelled white blood cell scan when looking for infection in bones and joints	Bone marrow scan	No patient preparation	1-1½ hours
Liver/spleen			
Assess size, shape, position and function of liver and spleen helping to diagnose: • focal disease (tumour, abscess, cyst, trauma) • chronic liver disease • portal hypertension	Liver/spleen scan	No patient preparation Patients should not have had a barium meal or enema in the preceding 48 hours.	1-1½ hours
Evaluate liver mass to diagnose (or exclude) haemangioma	Labelled red blood cell liver/ haemangioma scan (sometimes called a liver blood pool scan)	No patient preparation	3-4 hours
Examine the spleen or identify sites of residual splenic tissue if the spleen has been damaged, operated on or removed in the past	Heat damaged red blood cell scan	No patient preparation	2-3 hours

CLINICAL INDICATION	PROCEDURE TO REQUEST	PATIENT PREPARATION	APPROXIMATE TIME
Lung			
• Suspected pulmonary embolism	Ventilation/perfusion (V/Q) lung scan	No patient preparation	1 hour
• Pre-operative assessment for lung volume reduction surgery	Lung perfusion scan	Helpful for patient to have had recent chest x-ray (within 24 hours of scan) - to come with patient	1 hour
• Ventilation lung clearance studies to assess activity of inflammatory lung disease	Lung ventilation study with dynamic images		1 hour
Lymphatic System			
Lymphoedema	(Peripheral) lymphoscintigraphy	No patient preparation	Up to 4 hours
Assess lymph drainage and identify sentinel lymph nodes, particularly in breast cancer and melanoma	Sentinel node scan/ lymphoscintigraphy	No patient preparation	Up to 3 hours
Lymphoma			
Staging and monitoring therapy	Gallium scan Consider ^{18}F-FDG PET scan as an alternative where available	No patient preparation Please contact your nuclear medicine service regarding timing of scan in relation to chemotherapy	At least 2 appointments: 1. for injection of radiopharmaceutical - allow 30 minutes 2. return 24 or 48 hours later for scan - allow 1-2 hours. 3. Some patients may need to return for further scan - allow 1-2 hours.

CLINICAL INDICATION	PROCEDURE TO REQUEST	PATIENT PREPARATION	APPROXIMATE TIME
Renal/Urinary Tract If uncertain which renal scan to request, please discuss with nuclear medicine specialist.			
• Assess renal function, relative renal function. Can be very useful in assessing the function of renal transplant grafts. • Assess urinary drainage	DTPA or MAG3 renal scan with or without Frusemide	Patients should eat as normal then drink 2-4 glasses of water in the hour before their appointment.	1-3 hours
• Hypertension where narrowing of the renal arteries is suspected	DTPA or MAG3 renal scan with or without ACE inhibitor (usually Captopril)	Check with nuclear medicine service whether any medications such as diuretics or antihypertensives need to be stopped prior to the test.	1-3 hours
Displays viable cortical tissue, allows measurement of relative renal function, very sensitive test to indicate the presence of renal scars or active infection (pyelonephritis)	DMSA renal scan	No patient preparation	Up to 5 hours
Renal function	Glomerular filtration rate (GFR)	No patient preparation	Up to 4 hours
Urinary reflux	Cystogram	No fluids for 4 hours before test	1 hour
Thyroid			
• Hyperthyroidism (e.g. Graves Disease, thyroiditis, toxic adenomas) • Enlargement of thyroid gland (goitre) • Thyroid nodules	Thyroid scan	Generally no patient preparation Thyroid medication may need to be stopped before the test. Patients will be instructed accordingly when their appointment is made. When making their appointment, patients should advise staff if they have had a contrast injection (e.g. for a CT scan) in the previous 4 weeks.	1 hour

CLINICAL INDICATION	PROCEDURE TO REQUEST	PATIENT PREPARATION	APPROXIMATE TIME
• Determine whether there is any residual normal thyroid tissue following thyroid surgery • Determine whether there is any residual, iodine-avid thyroid tumour	I-123 or I-131 whole body scan	Some medication needs to cease before the test. Patients will be instructed as to which medications when their appointment is made. Patients may need to cease thyroxine tablets for a few weeks prior to the test to evaluate the TSH level or, alternatively, may be prescribed rTSH (Thyrogen) injections. Patients will be instructed accordingly when their appointment is made. Patients usually require blood tests on the day before the scan to check whether any thyroid tissue is stimulated or on the level of thyroid stimulation. Female patients may require a blood test prior to administration of the radioactive iodine to exclude pregnancy. An appointment should be made accordingly.	Blood test the previous day if required. At least 2 appointments: 1. To take I-123 (drink) or I-131 (capsule) - allow 30 minutes 2. Return 1-3 days later for scan - allow 1-2 hours.

Other Endocrinology

Assess for parathyroid adenoma or hyperparathyroidism, often when elevated blood calcium levels have been detected.	Parathyroid scan	No patient preparation	Up to 4 hours
Suspected phaeochromocytoma or other tumours composed of cells derived from, or related to, medullary cells of the adrenal glands.	MIBG (adrenal) scan	Many drugs can interfere with this study and may need to be stopped for up to a week or longer before the scan. Please contact the nuclear medicine service for specific information.	Up to 24 hours

CLINICAL INDICATION	PROCEDURE TO REQUEST	PATIENT PREPARATION	APPROXIMATE TIME
Tumours (other than, e.g. bone, brain, lymphoma, thyroid as listed above)			
Carcinoid (neuroendocrine) tumours	Indium-labelled octreotide scan. Consider ^{68}Ga-Dotatate PET scan as an alternative, where available.	No patient preparation If the patient is receiving therapeutic octreotide injections, please contact the nuclear medicine service to discuss optimal scheduling.	Scans are generally performed 4-6 and 24 hours after injection of radiopharmaceutical. Allow 1-1½ hours for each scan. Occasionally, delayed views are required at 48 hours.
Other tumours	Gallium, Thallium, DMSA and MIBI scans can be useful in diagnosing a wide variety of tumour types.	Contact the nuclear medicine service to discuss the most appropriate scan for a given patient. Ask the nuclear medicine service for information regarding patient preparation and approximate time required for the scan to be performed.	

Other indications

Blockage in lacrimal drainage system (excessive tearing)	Lacrimal scan	No patient preparation	Up to 1 hour
Assess presence/patency of Leveen shunt	Leveen shunt scan/ study	No patient preparation	Up to 4 hours

Nuclear Medicine Therapy

Commonly used nuclear medicine therapies include Radioactive iodine (I-131), used to treat hyperthyroidism and thyroid cancer, Yttrium-90 for arthritis, and Samarium-153 EDTMP or Strontium-89 for painful bone metastases. For more information about nuclear medicine therapies that are available, please discuss the therapeutic needs of your patient with a nuclear medicine specialist and ask for a copy of the AANMS's Nuclear Medicine Therapy Guide.

PET SCANS

NOTE ▪ Not all indications where PET would be useful are covered by Medicare so please discuss with your nuclear medicine specialist colleague. ▪ In Australia, most PET scanners operate in conjunction with a low dose CT for purposes of anatomical localisation and attenuation correction. ▪ The term 'PET' includes PET/CT.

PET scans currently attracting Medicare benefits

CLINICAL CONDITION	WHEN TO USE PET	MEDICARE ELIGIBLE
Brain cancer	Assessment of primary brain tumours Assessment of grade and recurrent disease post-therapy	For evaluation of suspected residual or recurrent malignant brain tumour based on anatomical imaging findings, after definitive therapy (or during ongoing chemotherapy) in patients who are considered suitable for further active therapy.
Cervical cancer	Initial staging Assessment of recurrent disease Guide radiotherapy treatment planning	For the further primary staging of patients with histologically proven carcinoma of the uterine cervix, at FIGO stage IB2 or greater by conventional staging, prior to planned radical radiation therapy or combined modality therapy with curative intent. For the further staging of patients with confirmed local recurrence of carcinoma of the uterine cervix considered suitable for salvage pelvic chemoradiotherapy or pelvic exenteration with curative intent.
Colorectal cancer	Staging following pathological confirmation Determine treatment effectiveness Suspected recurrence with rising CEA Pre- and post-surgical metastatic assessment Guide radiotherapy treatment planning	Following initial therapy, for evaluation of suspected residual, metastatic or recurrent colorectal carcinoma in patients considered suitable for active therapy.
Head & neck cancer	Staging to guide treatment Investigate metastatic disease involving cervical lymph nodes from an unknown primary site Determine treatment effectiveness Assess recurrence - Post surgical anatomical changes reduce accuracy of assessment using CT alone Guide radiotherapy treatment planning	For the staging of biopsy-proven, newly diagnosed or recurrent head and neck cancer. For the evaluation of patients with suspected residual head and neck cancer after definitive treatment, and who are suitable for active therapy. For the evaluation of metastatic squamous cell carcinoma of an unknown primary site involving cervical nodes.

CLINICAL CONDITION	WHEN TO USE PET	MEDICARE ELIGIBLE
Lung cancer (Non-small cell)	Staging following pathological confirmation Pre-treatment metastatic assessment Determine treatment effectiveness Assess suspected recurrence Guide radiotherapy treatment planning	For the staging of proven non-small cell lung cancer, where curative surgery or radiotherapy is planned.
Lymphomas	Stage known disease to guide treatment Pre- and post-chemotherapy monitoring Guide radiotherapy treatment planning	For the initial staging of indolent non-Hodgkin's lymphoma where clinical, pathological and imaging findings indicate that the stage is I or IIA and the proposed management is definitive radiotherapy with curative intent. For the initial staging of newly diagnosed or previously untreated Hodgkin's or non-Hodgkin's lymphoma (excluding indolent non-Hodgkin's lymphoma). For re-staging following confirmation of recurrence of Hodgkin's or non-Hodgkin's lymphoma (excluding indolent non-Hodgkin's lymphoma). To assess response to first line therapy either during treatment or within three months of completing definitive first line treatment for Hodgkin's or non-Hodgkin's lymphoma (excluding indolent non-Hodgkin's lymphoma). To assess response to second-line chemotherapy when stem cell transplantation is being considered, for Hodgkin's or non-Hodgkin's lymphoma (excluding indolent non-Hodgkin's lymphoma).
Melanoma	Initial staging for distant metastases to guide treatment Pre- and post-chemotherapy to assess treatment effectiveness Localise and restage possible recurrence **Not indicated for staging of regional node involvement**	Following initial therapy, for evaluation of suspected metastatic or recurrent malignant melanoma in patients considered suitable for active therapy.

CLINICAL CONDITION	WHEN TO USE PET	MEDICARE ELIGIBLE
Oesophageal/ gastro-oesophageal junction cancer	Staging of regional and distant metastases Pre- and post-treatment assessment of metastatic disease Assess effect of neoadjuvant chemoradiotherapy Assess suspected recurrence Guide radiotherapy treatment planning	For the staging of proven oesophageal or gastro-oesophageal junction carcinoma, in patients considered suitable for active therapy.
Ovarian cancer	Initial staging for distant metastases to guide treatment Following initial therapy, evaluate suspected residual, metastatic or recurrent carcinoma in patients considered suitable for active therapy	Following initial therapy, for evaluation of suspected residual, metastatic or recurrent ovarian carcinoma in patients considered suitable for active therapy.
Refractory epilepsy	Localise seizure focus prior to surgery	For refractory epilepsy which is being evaluated for surgery.
Sarcoma	Guide biopsy of a suspected sarcoma Staging of biopsy-proven sarcoma being considered for resection of the primary or limited metastatic disease Evaluation of suspected residual or recurrent sarcoma on structural imaging after definitive therapy	For initial staging of patients with biopsy-proven bone or soft tissue sarcoma (excluding gastrointestinal stromal tumour) considered by conventional staging to be potentially curable. For the evaluation of patients with suspected residual or recurrent sarcoma (excluding gastrointestinal stromal tumour) after the initial course of definitive therapy to determine suitability for subsequent therapy with curative intent.
Solitary pulmonary nodule	Solitary pulmonary nodules between 0.5-3 cm	For evaluation of a solitary pulmonary nodule where the lesion is considered unsuitable for transthoracic fine needle aspiration biopsy, or for which an attempt at pathological characterisation has failed.

NOT currently funded under Medicare

CLINICAL CONDITION	WHEN TO USE PET	NOTES ON MEDICARE ELIGIBILITY
Adenocarcinoma of unknown primary	Identify location of primary in adenocarcinoma of unknown primary site	
Bone cancer	Assessment of possible metastatic disease	
Breast cancer	Initial staging for distant metastases to guide treatment Pre- and post-chemotherapy for treatment effectiveness	See below…
… Breast cancer	Assess possible recurrence Guide radiotherapy treatment planning **Not indicated for primary/initial diagnosis** **Not indicated for initial staging of axilla**	An application for funding for PET for breast cancer prepared by AANMS is currently being evaluated by MSAC.
Cholangiocarcinoma	Detection of distant metastatic disease at the time of initial diagnosis	AANMS is currently preparing an MSAC application.
Dementia	Differentiate Alzheimer's disease from other forms of dementia such as frontotemporal dementia Following 6 months of documented symptoms Following MMSE evaluation Following equivocal MRI When Alzheimer's disease diagnosis is still in question	An application for funding of PET for Alzheimer's disease is currently being evaluated by MSAC.
Gastric cancer	May be useful for staging	
Gastrointestinal stromal tumour (GIST)	Assessment and management of patients with GIST	
Hepatobiliary Carcinoma	Detection of distant metastatic disease at the time of initial diagnosis Staging as an adjunct to conventional anatomic imaging	AANMS is currently preparing an MSAC application.
Merkel cell cancer	Staging of patients for regional lymphadenopathy and metastases prior to definitive treatment Assessment of recurrent disease	
Myocardial viability	Assessment of extent of viable myocardium prior to consideration of possible revascularization	
Neuroendocrine tumour	^{68}Gallium labelled tracers, e.g. DOTATOC, DOTANOC for assessment of suspected neuroendocrine tumour	
Pancreatic cancer	Initial staging and detection of distant metastatic disease at the time of initial diagnosis Evaluation of response to therapy	AANMS is currently preparing an MSAC application.
Thyroid cancer	Restaging after surgery and radioablation in patients with negative radioiodine scans and ultrasound or biochemical evidence of recurrent disease	

Source: Australasian Association of Nuclear Medicine Specialists (AANMS), Academy of Molecular Imaging (AMI), National Oncologic PET Registry

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