

SNMMI clinical guidelines

<http://www.snmmi.org/ClinicalPractice/content.aspx?ItemNumber=10817&navItemNumber=10786>

Pediatric activity should follow image gently guidelines <https://www.imagegently.org/Procedures/Nuclear-Medicine>

Radiopharmaceutical- Technetium Labeled	Trade Name "Common name"	Clinical Use	Dosages* (mCi)
<u>99mTc Physical Half-life (P) 6h</u> Technetium-99m-pertechnetate (from Molybdenum-99 generator) High Specific Activity from LEU of U235 fission Q9969 \$10	"Tech" "TcO4" "Tc99m" "99mTc"	Labeling chelates Thyroid Imaging Salivary gland function Dacryoscintigraphy Cystography Meckel's	Range 10 10 0.1 1 10
Tc99m pertechnetate labeled carbon sys.	Technegas aerosol, 9/2023 Cyclomedica; C9150 per study dose	Ventilation	30
Tc99m-bicisate (ECD)	Neurolite Lantheus; A9557 per study dose; up to 25 mCi	Brain perfusion imaging	25
Tc99m-disofenin (DISIDA)	Hepatolite (Pharma is DC Dec 2019)	Hepatobiliary Imaging Gallbladder EF	5
Tc99m-exametazine (HMPAO)	Ceretec-available from DraxImage and GE; A9521 up to 25 mCi A9569 WBC per study dose	Brain perfusion imaging- stabilized Infection WBC label- unstabilized	25 Range
Tc99m-macroaggregated albumin	"MAA" Curium and DraxImage; A9540 up to 10 mCi	Pulmonary perfusion and embolism, Pre Y-90 SIR Spheres distribution test	Particle dependen t 3-5
Tc99m-mebrofenin	Choletec "Mebro" Bracco, Sun Pharma; A9537 up to 15 mCi	Hepatobiliary Imaging Gallbladder EF	5
Tc99m-medronate	"MDP" DraxImage MDP-25; Cardinal Health, Sun Pharma A9503	Bone imaging	25
Tc99m-mertiatide	"MAG3" Curium, DraxImage, Sun Pharma; A9562 up to 15 mCi	Renal imaging (ERPF)	10
Tc99m-oxidronate	"HDP" Curium; A9561; up to 30 mCi	Bone imaging	25
Tc99m-pentetate Pentetate Kit Jubilant-Drax (12/89)	"DTPA" DraxImage; A9539 up to 25 mCi A9567 up to 75 mCi	Renal imaging (GFR function, renal flow studies) Lung Ventilation for matching with MAA Cardiac first pass Cerebral-Peritoneal shunt	3, 10 35-75 25 1

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Tc99m-pyrophosphate Cis-Pyro Sun Pharm (6/87) Technescan PYP Kit Curium (5/74)	“Hot pyp” A9538 up to 25 mCi “Cold pyp” or “pyp”	Amyloidosis TTR-CM (transthyretin- cardiomyopathy) Myocardial infarct imaging Cisternography-2013 Tin used for labeling RBC	15 25 1 0
Tc99m-red blood cells	Ultratag Curium; A9560; per study dose; up to 30 mCi	GI bleeds Hemangioma ENVG (MUGA) RNVG (MUGA) L to R shunt Spleen (heat damaged RBC’s)	30 30 30 30 30 30
Tc99m-sestamibi Cardinal Health, Curium, DraxImage, Lantheus, Sun Pharma A9500 Per study dose up to 40 mCi	Cardiolite, “Sestamibi” or “mibi”	Myocardial perfusion Breast tumor Parathyroid	10/30 25 25

Tc99m-succimer	“DMSA” Nephroskan Feb 2022 Theragnostics Distributed by GE; A9551 up to 10 mCi	Renal cortical imaging	5 0.1 to 0.05 ped
Tc99m-sulfur colloid AN-Sulfur Colloid Sun Pharm (4/79) Sulfur Colloid Kit Jubilant-Drax (11/23)	“Sulfur colloid”	Liver-spleen, Bone marrow Lymphoscintigraphy Gastric emptying Gastric reflux Aspiration/Salivagram Cystography (augmented bladder) Peritoneo-venous shunt (LeVeen shunt)	5 0.4 1 0.3 0.2 1 0.5
Tc99m-tetrofosmin Myoview GE (2/96 – 0.23 mg) Myoview 30 GE (3/05 - 0.69 mg)	Myoview A9502 Per study dose	Myocardial perfusion imaging	10/30
Tc99m-tilmanocept	Lymphoseek (Cardinal Health 2017) A9520 up to 0.5 mCi	Lymphoscintigraphy	0.5

*ACR–SPR (American College of Radiology-Society of Pediatric Radiology) Technical Standard for Diagnostic Procedures Using Radiopharmaceuticals. Available at: <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/Radiopharmaceuticals.pdf>. Revised 2016. American College of Radiology. ACR-AAPM practice parameter for reference levels and achievable administered activity for

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nuclear medicine and molecular imaging. 2015; Available at: <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/RefLevels-NucMed.pdf>.

Radiopharmaceutical Cyclotron PET Prod.	Trade Name “Common name”	Clinical Use	Dosages (mCi)
Carbon-11 choline (2013) (P = 20 min)	Mayo Clinic-Rochester, Minn, Zevacor ANDA A9515 up to 20 mCi	Prostate cancer recurrence	10-20
Copper (Cu)-64 dotatate (8/20) (P = 12.6hr)	DETECTNET (Curium) Available everyday & Friday after 10:30 Pass- through until Jan 1 2024; 69945- 0064-01;	Somatostatin receptor positive neuroendocrine tumors	4.4
Flourine-18 florbetaben (P = 109 min)	NEURACEQ Life Molecular Imaging (Primal) Contract manufacturing Distributed by SOFIE-DALLAS – TU/WED/TH after 1200 Q9983 up to 8.1 mCi	Risk of Alzheimer’s Imaging 45-130 min post admin.	8.1
Flourine-18 florbetapir	AMYVID (Lilly) Contract manufacturing Distributed by Petnet and some Cardinal PET facilities; A9586 up to 10 mCi	Risk of Alzheimer’s Imaging 50 min post admin.	10
Fluorine-18 flortaucipir (5/20)	TAUVID™ (Avid Radiopharmaceuticals, Inc bought by Lilly) Contract Manufacturing Distributed by Petnet and some Cardinal PET facilities; A9601 per 1 mCi	Risk of Alzheimer’s	10
Fluorine-18 flotufolastat (5/23)	POSLUMA (Blue Earth Diag.) Distributed by PetNet-Dallas & Tulsa; A9608 =	Prostate cancer initial or recurrence	8
Fluorine-18 fludeoxyglucose	“FDG” Various ANDA; A9552 up to 45 mCi	Primarily metastasis, but all metabolism and glycolysis, e.g., active inflammation, tissue repair	10
Fluorine-18 fluciclovine (5/16)—Replaced by Posluma	AXUMIN (Blue Earth Diagnostics) Distributed by Petnet: Tulsa said they need to get it from Dallas.; A9588 per 1 mCi	Prostate cancer recurrence	10
Fluorine-18 fluorodopa (1/22)	Feinstein Institute, Manhasset, NY (Tom Chaly); NDA 200655 must have ANDA - GE FASTLAB 2 HPLC+). CMS has removed the NCD, PET centers could get the coverage for Fluorodopa PET studies through the local CMS contractors. A9602 =	Suspected parkinsonian syndromes-CMP or ANDA	5

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Fluorine-18 fluoroestradiol (5/20)	CERIANNA™ (GE) bought Zionexa, US) Contract manufacturing through PETNET – Dallas making on Monday and Wednesday; A9591 per 1 mCi	Estrogen receptor (ER)-positive lesions as an adjunct to biopsy in patients with recurrent or metastatic breast cancer	6
Fluorine-18 flurpiridaz (10/2024)	FLYRCADO (GE)	myocardial blood flow (MBF) 2.5 to 3 mCi rest/9 to 9.5 stress (1 hr apart); if pharmacologic use 6 to 6.5 mCi for stress (0.5 hr apart)	3/9
Fluorine-18 flutemetamol (10/13)	VIZAMYL (GE) Contract manufacturing Distributed by Pharmalogic and Cardinal PET facilities Q9982 Up to 5 mCi	Risk of Alzheimer's Imaging 90 min post admin.	5
Fluorine-18 piflufolastat (PSMA) (5/21)	PYLARIFY (GE) owned Progenics) Distributed by any contract manufacturer – right now Sofie DALLAS –delivery starting at 1 pm to OKC and PetNet in Tulsa (July 2023) A9595 =	Prostate cancer initial and recurrence	8-10
Fluorine-18 sodium fluoride	"NaF" Various ANDA; A9580 up to 30 mCi	Bone metastasis	5
Gallium-68 dotatoc (8/19) (P = 68 min)	Univ of Iowa Hosp & Clinics; Various ANDA	Somatostatin receptor positive neuroendocrine tumors	4
Gallium-68 dotatate (6/16)	NETSPOT (Advanced Accelerator Applications- Novartis) Generator distribution various; A9587 per 0.1 mCi; 69488-0001-40; =	Somatostatin receptor positive neuroendocrine tumors Pass-through ended Jan 2022	5.4
Gallium-68 PSMA – CALI-cGMP 212 (approved 12/2020) Gallium-68 PSMA (KIT)	CALI-cGMP under 212: PSMA-11 with HBED-CC chelator; A9594 <u>FDA approved: Telix: Feb 2022</u> ⁶⁸ Ga- HBED-PSMA-11 (gozetotide- Illucix); A9596 <u>Novartis/AAA: Mar 2022</u> ⁶⁸ Ga-HBED- PSMA-11 (gozetotide- Locametz) A9800 69488-0017-61; Not approved yet: <u>Theragnostics/GE:</u> <u>now AAA agreement distribution:</u> (GalliProst) ⁶⁸ Ga-THP-PSMA THP-no heating	Prostate-specific membrane antigen (PSMA) positive lesions in men with prostate cancer with suspected metastasis who are candidates for <u>initial definitive</u> <u>therapy</u> or with suspected recurrence based on <u>elevated</u> serum prostate-specific antigen (PSA) level	3-7 PI 3-5 reg \$ 6 =\$\$ 7 =\$\$\$
Nitrogen-13 ammonia (P = 10m)	"Ammonia" Various ANDA; A9526 up to 40 mCi	Myocardial perfusion	10-20
Rubidium-82 Chloride (Sr-82 generator) (P = 75s)	Cardio-Gen-82 (Bracco) Ruby-Fill (DraxImage); A9555 up to 60 mCi per study dose	PET cardiac perfusion imaging	30-60

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Radiopharmaceutical Cyclotron Prod. NON- PET	Trade Name "Common name"	Clinical Use	Dosages (mCi)
Gallium-67 citrate (P=78h)	"Gallium" (Lantheus DC 2022); A9556 per mCi	Soft-tissue tumor Inflammatory process imaging	7
Indium-111 chloride (P=68h)	Indiclor (Curium)	Labeling monoclonal antibodies and peptides	3 to 9
Indium-111 pentetate MPI Indium DTPA GE (2/82)	Indium DTPA (GE) A9548 per 0.5 mCi	Cerebral Spinal Fluid (CSF) kinetics	0.5
Indium-111 oxyquinoline	Indium Oxine (GE 12/85) and (BWXT 7/2018); A9547 per 0.5 mCi; A9570 WBC per study dose	Labeling leukocytes and platelets	0.7
Indium-111 pentetreotide	Octreoscan (Covidian); A9572 up to 6 mCi	Imaging neuroendocrine tumors	6
Iodine-123 iobenguane (metaiodobenzylguanidine) (P=13.2h) A9582	Adreview-GE; A9582 up to 15 mCi; 17156-0235-01;	Neuroendocrine tumor imaging 78803 Sympathetic nerve activity in heart failure 0332T	7.5
Iodine-123 ioflupane (A9584)	DatScan –GE; 17156-0210-01; AWP \$2961 ioflupane- Curium (3/2022) M-F early delivery; A9584 up to 5 mCi;	Dopamine receptor imaging for Parkinson's disease 78803	5
Iodine-123 sodium iodide	"123 caps" Curium, Cardinal A9509 Use for 1-4 mCi doses of I-123 for whole body imaging for less than 1 mCi and thyroid imaging see A9516 100 to 999 mCi	Thyroid imaging and uptake	0.3
Thallium-201 Chloride (P=73h) Thallos Chloride Curium (10/79)	"Thallium" (Lantheus DC 2022); (Curium Not Returned to market 12/2022) TRACE (Discontinued Mount Sinai Medical Center, FL. 11/2001)	Myocardial perfusion imaging Parathyroid Tumor imaging	4

Radiopharmaceutical Naturally Occurring Radionuclides	Trade Name "Common name"	Clinical Use	Dosages (mCi)
Carbon-14 Urea (P=5,730y)	Pytest TriMed 2023 (from AVENT DC Dec 2023) 510-947-6828 trimedamericas.com	Detection of H. Pylori infection	0.001

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Radiopharmaceutical Reactor Products	Trade Name "Common name"	Clinical Use	Dosages (mCi)
Strontium-89 (P=52.7d)	Metastron (GE DC MF FEB 2019; available BioMed through Triad-Drax 2020); A9600	Palliative treatment of bone pain of skeletal metastases	4
Iodine-125 human serum albumin (P=60d)	Jeanatope, "RISA" (IsoTex); A9532 per 5 mcrCi	Plasma volume determination	0.005 – 0.01
Iodine-125 iothalamate	Glofil (IsoTex)	Measurement of glomerular filtration	0.01-0.03
Iodine-131 human serum albumin (P=8d)	Megatope (IsoTex); A9524 per 5 mcrCi	Vascular volume studies-protein turnover studies	0.01
Iodine-131 metaiodobenzylguanidine	I-131 MIBG;	Pheochromocytomas and neuroblastomas Diagnostic	0.5
Iodine-131 sodium iodide	"Iodine" Draximage, International Isotopes; A9517	Whole Body Scan Thyroid therapy	2 10 - 200
Xenon-133 gas (5.2d)	"Xenon" Curium, Lantheus ; A9558 per 10 mCi	Pulmonary ventilation imaging	10-20
Yttrium-90 ibritumomab (P=64h)	ZEVALIN (Spectrum); A9543 up to 40 mCi	Non-Hodgkin's lymphoma	32 max
Radium-223 dichloride (P=11.4d) Ac227>Th227>Ra223	XOFIGO (Bayer distributed by Cardinal Health-DENVER)-A9606	CRPC with symptomatic bone metastases 4-apha decays with gamma 81 keV (15%), 84 (24%), and 154 5%	About 0.14 total x6
Lutetium Lu-177 dotatate (P=6.6d)	LUTAHERA (AAA) Feb 2018 (DISTRIBUTED TO HOSPITAL IN VIAL) Lu-177m (Tp1/2 160 days) contaminant [Lu-176(n,g)Lu177 & Lu177m] A9513	NE Tumors with somatostatin receptors	200 q8 wks x 4 doses
Lutetium Lu-177 vipivotide tetraxetan (March 2022)	Pluvicto -Endocyte/Novartis/AAA lutetium-177 (Lu-177) PSMA 617 [n.c.a Yb-177(n,g) Lu-177] A9607	Metastatic Prostate Treatment -	200 q6wks x6 doses

*Usual dosage range of radiopharmaceutical used, dosages are adjusted for patients weight, sex, and clinical diagnosis. Pediatric doses are appropriately lowered on age and weight bases. ACR-SPR (American College of Radiology-Society of Pediatric Radiology) Technical Standard for Diagnostic Procedures Using Radiopharmaceuticals. Available at: <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/Radiopharmaceuticals.pdf>. Revised 2016. American College of Radiology. ACR-AAPM practice parameter for reference levels and achievable administered activity for nuclear medicine and molecular imaging. 2015; Available at: <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/RefLevels-NucMed.pdf>.

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Investigational Radiopharmaceuticals		Indication
F-18	126 FDA registered ongoing clinical trials FLT (AML) and FMISO (hypoxia)	18F-flurpiridaz (MBF) -NOS (inflammation in every disease state)-FMAU (uracil agent –cancer) –FEOBV (Parkinson) -FTT (PARP inhibitor breast/ovarian) –FAZA (lung) –FCH (hepatocarcinoma) –TFB (thyroid) -CETO (primary aldosteronism) –FSPG (liver) -PSS232 (amyotrophic lateral sclerosis)
Zr-89	7	-panitumumab (squamous cell head and neck) –DFO-YS5 (multiple myeloma) –Df crefmirlimab (CD8 Tcells) –AP-101 (ALS)
Ac-225	15	-FPI (neurotensin receptor tumors) –daratumumab (AML)
Lu-177	55	-dotatate (Breast, pancreatic, meningioma, CNS) – PMSA (prostate)

Brachytherapy Devices	Trade Name “Common name”	Indication
Iodine-125 iodohydroxybenzenesulfonate (LIQUID) & Cesium-131 Chloride in NS (LIQUID)	Iotrex Cesitrex	Use in GliaSite device for recurrent malignant gliomas – MFG change now IsoRay in Richland, WA (2014)
Ir-192 (P=74d)	Checkmate	Decrease in-stent restenosis
Sr-90 (P=29y)	Novoste BetaCath	Decrease in-stent restenosis
P-32 (P=14d)	Guidant Galileo	Decrease in-stent restenosis
Y-90 glass (64h)	TheraSphere	Hepatocarcinoma
Y-90 resin-polymer	SIR-Spheres	Hepatocarcinoma/Colorectal mets 27-81 mCi