

Nuclear Medicine Service in Malaysia

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**Head of Nuclear Medicine Service,
Ministry of Health, Malaysia**

RAS6083/9001/01, IAEA/RCA Initial Project Planning Meeting,
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1. Introduction of status of NM and referral system in Malaysia
2. Types of NM procedures performed in Malaysia
3. List of NM centers in Malaysia
4. SWOT analysis to improve and enhance NM service in Malaysia
5. Availability and cost of RP
6. Steps to promote NM at National and Regional level

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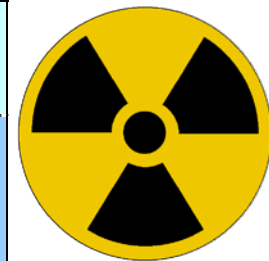
Hospital Kuala Lumpur	1964: Dept of Radiotherapy 1993: Dept. of Medicine 2006: Dept. of Nuclear Medicine
Hospital Umum Sarawak	1986: Dept of Medicine 1997: Dept. of Radiotherapy 2002: Dept. of Diagnostic Imaging 2005: Dept. of Nuclear Medicine
Hospital Pulau Pinang	1995: Dept. of Diagnostic Imaging 2005: Dept. of Nuclear Medicine
Hospital Sultanah Aminah, Johor Bahru	1997: Dept. of Diagnostic Imaging 2002: Dept. of Medicine 2008: Dept. of Nuclear Medicine

Establishing Our Identity!



Types of Ionizing Radiation Sources used in Medicine

Source	Types of ionizing radiation	Speciality
Machine-generated X-rays	Low photon energy (e.g. conventional X-ray, CT scan)	Conventional Radiology
	<u>Teletherapy / Radiosurgery</u> High photon energy (e.g. LINAC device for teletherapy and radiosurgery)	Radiotherapy / Oncology
Sealed or solid radioactive sources	<u>Teletherapy / Radiosurgery</u> Source head of the machine is housed with sealed radionuclides (e.g. Co-60 in gamma-knife for stereotactic radiosurgery)	
	<u>Brachytherapy</u> Sealed radioactive source in the form of insoluble compounds, ceramics or metal foils or wires (e.g. Cs-137 needles)	Nuclear Medicine
Unsealed radioactive sources (Radiotracers / radiopharmaceuticals)	<u>For treatment</u> β-rays (particulate emissions) (e.g. Sr-89, P-32)	
	<u>For diagnosis & treatment</u> Both β and γ-rays (e.g. I-131, Re-186)	
	<u>For diagnosis</u> γ-rays and positron emissions Imaging (e.g. Tc-99m, In-111, F-18, C-11, I-124 etc.) Non-imaging (e.g. Cr-51)	



**Ionizing
Radiation**

What is Radiopharmaceutical / Radiotracer?

Any medical product which contains or generates a radioactive substance and which is, contains or generates that substance, in order, when administered to a human being, to utilize the radiation emitted therefore.

These includes inorganic compound, organic compound, peptide proteins, monoclonal antibodies and fragment, and oligonucleotide **labelled with radionuclides** with half-life from a few seconds to several days for diagnostic and therapeutic use.

“Drug labelled with radionuclides”

Over the last decade or so ...

Nuclear Medicine has been integrated into our national healthcare system on par with other disciplines such as radiology, radiotherapy (clinical oncology). At this point, nuclear medicine have found its proper place among contemporary healthcare technologies.

Its **future** will depend on having a clear picture in the way to expand this service, making it available, accessible and affordable to patients who need its service.

Category of NM Centers

The nuclear medicine set up under the Ministry of Health (MoH) can be categorized into 2 levels:

Level 1: Diagnostic & Outpatient Therapy Service

Level 2: Level 1 + Inpatient Therapy Service

Depending on the availability of equipment and facility, each center is assigned with following subset:

Subset **s** : with SPECT service

Subset **p** : with PET service

Subset **sp** : with both SPECT & PET services

Nuclear medicine services under MoH are currently provided through 5 regional centres, i.e.:

Peninsular Malaysia

Northern region : Hospital Pulau Pinang (Level 2sp)

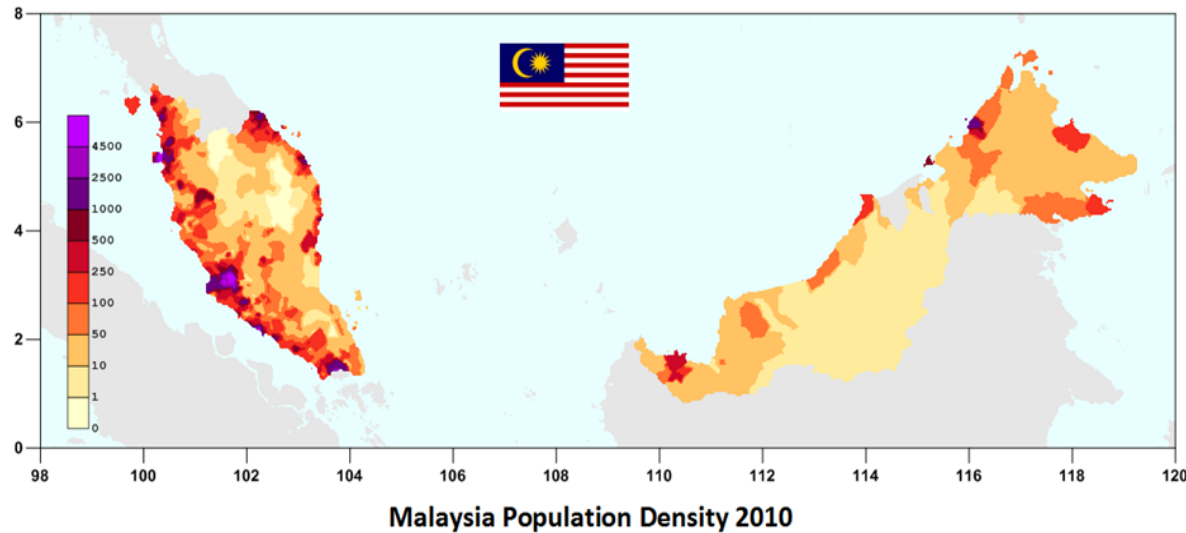
Central region : Hospital Kuala Lumpur (Level 2s) &
National Cancer Institute (Level 2sp)

Southern region : Hospital Sultanah Aminah (Level 1s)

East Malaysia

Sarawak : Hospital Umum Sarawak (Level 2s)

Sabah : Sabah Women and Children Hospital (Level 2s)



REGIONAL BASED NUCLEAR MEDICINE SERVICE APPROACH



*Out of the 6 nuclear medicine centres under MoH, one is still under the category of Level 1(**blue**) and only 2 centres are equipped with PET-CT service (**red**). There is no MoH nuclear medicine centre at the east coast of the peninsular Malaysia.*

Root of Authority:

1. Training for the Specialty
2. Registration Specialists Practice
3. Licensing for Nuclear Medicine Service & Operation

Patients



MoH
Hospitals



Private
Hospitals

MoH Hospitals

Private Hospitals



MoH Nuclear
Medicine Centers

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Diagnostic Procedures:

1	Skeletal System : Bone scintigraphy, Tc-99m based radionuclide - Whole body +/-Regional
2	Skeletal System : Bone scintigraphy, Tc-99m based radionuclide - 3 Phase
3	Skeletal System : Bone scintigraphy, F-18 based radionuclide (refer PET-CT)
4	Genitourinary system : Dynamic Renal Scintigraphy - Tc-99m diethylinetriamine penta acetic acid (DTPA)
5	Genitourinary system : Dynamic Renal Scintigraphy - Tc-99m diethylinetriamine penta acetic acid (DTPA) with Captopril challenge
6	Genitourinary system : Dynamic Renal Scintigraphy - Tc-99m diethylinetriamine penta acetic acid (DTPA), with GFR radiobioassay done
7	Genitourinary system : Dynamic Renal Scintigraphy - Tc-99m mercaptoacetyltriglycine (MAG-3)
8	Genitourinary system : Dynamic Renal Scintigraphy - Tc-99m mercaptoacetyltriglycine (MAG-3) with Captopril challenge
9	Genitourinary system : Cortical Renal Scintigraphy - Tc-99m dimercaptosuccinic acid (DMSA)
10	Genitourinary system : Direct radionuclide cystography, Tc-99m based radionuclide
11	Genitourinary system : Testicular scan, Tc-99m pertechnetate
12	Cardiovascular system : Myocardial perfusion scintigraphy - Stress study using Tc-99m based radionuclide
13	Cardiovascular system : Myocardial perfusion scintigraphy - Rest study using Tc-99m based radionuclide
14	Cardiovascular system : Multigated blood pool scintigraphy, Tc-99m based radionuclide
15	Cardiovascular system : Myocardial Metabolic Study (refer PET-CT)
16	Cardiovascular system : Cardiac shunt / first pass scintigraphy, Tc-99m based radionuclide

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2	Skeletal System : Bone scintigraphy, Tc-99m based radionuclide - 3 Phase
3	Skeletal System : Bone scintigraphy, F-18 based radionuclide (refer PET-CT)
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11	Genitourinary system : Testicular scan, Tc-99m pertechnetate
12	Cardiovascular system : Myocardial perfusion scintigraphy - Stress study using Tc-99m based radionuclide
13	Cardiovascular system : Myocardial perfusion scintigraphy - Rest study using Tc-99m based radionuclide
14	Cardiovascular system : Multigated blood pool scintigraphy, Tc-99m based radionuclide

17	Gastrointestinal and hepatobiliary system : Salivary gland scintigraphy, Tc-99m based radionuclide
18	Gastrointestinal and hepatobiliary system : Meckel's diverticulum scintigraphy, Tc-99m based radionuclide
19	Gastrointestinal and hepatobiliary system : Hepatobiliary scintigraphy, Tc-99m based radionuclide
20	Gastrointestinal and hepatobiliary system : Gastric emptying scintigraphy (solid-meal), Tc-99m based radionuclide
21	Gastrointestinal and hepatobiliary system : Liver/spleen scintigraphy, Tc-99m based radionuclide
22	Gastrointestinal and hepatobiliary system : Gastrointestinal tract (GIT) bleed scan, Tc-99m based radionuclide - Sulfur colloid
23	Gastrointestinal and hepatobiliary system : Gastrointestinal tract (GIT) bleed scan, Tc-99m based radionuclide - In-vitro RBC-tagged
24	Gastrointestinal and hepatobiliary system : Hepatic intraarterial MAA scintigraphy (in tandem with hepatic intraarterial procedure)
25	Respiratory system : Lung Ventilation Scintigraphy, Tc-99m based radionuclide
26	Respiratory system : Lung Perfusion Scintigraphy, Tc-99m based radionuclide
27	Endocrine system : Thyroid uptake scan using I-131
28	Endocrine system : Thyroid scintigraphy using Tc-99m Pertechnetate
29	Endocrine system : Whole body scan - I-131
30	Endocrine system : Whole body scan - I-124 (refer PET-CT)
31	Endocrine system : Parathyroid scintigraphy - Dual phase study using Tc-99m Sestamibi
32	Endocrine system : Parathyroid scintigraphy - Substraction study using Tc-99m based radionuclides
33	Endocrine system : Adrenal medullary scintigraphy (refer tumour imaging)
34	Endocrine system : Medullary thyroid cancer scintigraphy (refer tumour imaging)

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32	Endocrine system : Parathyroid scintigraphy - Substraction study using Tc-99m based radionuclides

35	Tumour Imaging : Adrenal medullary scintigraphy using I-131 MIBG
36	Tumour Imaging : Medullary thyroid cancer scintigraphy, Tc-99m DMSA(V)
37	Tumour Imaging : Post-therapy bremsstrahlung scintigraphy, β -emitters (refer add-on items)
38	Tumour Imaging : Post-therapy scintigraphy, Lu-177, Sm-153 or I-131 based (refer add-on items)
39	Tumour Imaging : Post-therapy PET-CT scintigraphy, Y-90 based (refer PET-CT)
40	Central nervous system : Cerebral Metabolism Scintigraphy (refer PET-CT)
41	Central nervous system : Brain Perfusion Scintigraphy using Tc-99m based radionuclide
42	Central nervous system : Brain Death Scintigraphy using Tc-99m diethylnetriamine penta acetic acid (DTPA) / Pertechnetate
43	Central nervous system : Ventriculo-peritoneal (VP) shunt scintigraphy, Tc-99m based radionuclide
44	Haematologic and Lymphatic System : Lymphoscintigraphy, Tc-99m based radionuclide
45	Haematologic and Lymphatic System: Sentinel Node Scintigraphy (excludes intra-operative gamma probe support service)
46	Haematologic and Lymphatic System : Liver/spleen scintigraphy (refer gastrointestinal and hepatobiliary)
47	Haematologic and Lymphatic System : Pre-therapy I-131 Rituximab mapping
48	Infection : Tc-99m based antigranulocyte antibody (Besilesomab)
49	Infection : F-18 FDG scintigraphy (refer PET-CT)
50	PET-CT Scintigraphy : Oncology and Infection - F-18 FDG
51	PET-CT Scintigraphy : Oncology and Infection - F-18 fluoride
52	PET-CT Scintigraphy : Oncology and Infection - Ga-68 DOTA-peptide
53	PET-CT Scintigraphy : Oncology and Infection - Ga-68 PSMA
54	PET-CT Scintigraphy : Oncology - I-124
55	PET-CT Scintigraphy : Cardiology - F-18 FDG
56	PET-CT Scintigraphy : Neurology - F-18 FDG
57	PET-CT Scintigraphy : Add-on Post-therapy PET-CT scintigraphy, Y-90 based
58	PET-CT Scintigraphy : Ancillary support in PET-CT simulation for RT planning - F-18 FDG

35	Tumour Imaging : Adrenal medullary scintigraphy using I-131 MIBG
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56	PET-CT Scintigraphy : Neurology - F-18 FDG
57	PET-CT Scintigraphy : Add-on Post-therapy PET-CT scintigraphy, Y-90 based

59	Others : Lacrimal duct scintigraphy (dacryoscintigraphy), Tc-99m pertechnetate
60	Others : Peritoneal Scintigraphy, Tc99m based radionuclide
61	Add-on Post-therapy scintigraphy, Lu-177, Sm-153 or I-131 based
62	Add-on Post-therapy bremsstrahlung scintigraphy, β -emitters
63	Add-on Post-therapy PET-CT scintigraphy, Y-90 based (refer PET-CT)
64	Intra-operative gamma probe support service
65	Non imaging : Glomerular filtration rate (GFR) measurement, Cr-51 ethylene diamine tetra acetic acid (EDTA)

Therapeutic Procedures:

1	Thyroid Therapy : I-131 ablation for thyroid cancer – less than 30 mCi
2	Thyroid Therapy : I-131 ablation for thyroid cancer - 30 mCi or more
3	Thyroid Therapy : I-131 treatment for thyrotoxicosis – less than 30 mCi
4	Palliative Bone Therapy : Strontium-89 (89Sr)
5	Palliative Bone Therapy : Samarium-153 based (153Sm)
6	Palliative Bone Therapy : Phosphorous-32 (32P)
7	I-131 MIBG Therapy
8	Radionuclide Therapy for polycythemia vera - Phosphorus-32
9	Radiosynovectomy : Yttrium-90 (90Y)
10	Radiosynovectomy : Rhenium-186 (186Re)
11	Radiosynovectomy : Erbium-169 (169Er)
12	Radioimmunotherapy : I-131 Rituximab
13	Radioimmunotherapy : Y-90 Ibritumomab
14	Selective Internal Radiation Therapy (SIRT) (done in tandem with hepatic intraarterial procedure) - Y-90 based microsphere
15	Peptide Radionuclide Receptor Therapy : Lu-177 labelled somatostatin analogue
16	Peptide Radionuclide Receptor Therapy : Y-90 labelled somatostatin analogue

59	Others : Lacrimal duct scintigraphy (dacryoscintigraphy), Tc-99m pertechnetate
61	Add-on Post-therapy scintigraphy, Lu-177, Sm-153 or I-131 based
62	Add-on Post-therapy bremsstrahlung scintigraphy, β -emitters
63	Add-on Post-therapy PET-CT scintigraphy, Y-90 based (refer PET-CT)
64	Intra-operative gamma probe support service
65	Non imaging : Glomerular filtration rate (GFR) measurement, Cr-51 ethylene diamine tetra acetic acid (EDTA)

Therapeutic Procedures:

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3	Thyroid Therapy : I-131 treatment for thyrotoxicosis – less than 30 mCi
4	Palliative Bone Therapy : Strontium-89 (89Sr)
7	I-131 MIBG Therapy
8	Radionuclide Therapy for polycythemia vera - Phosphorus-32
9	Radiosynovectomy : Yttrium-90 (90Y)
10	Radiosynovectomy : Rhenium-186 (186Re)
11	Radiosynovectomy : Erbium-169 (169Er)
12	Radioimmunotherapy : I-131 Rituximab
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14	Selective Internal Radiation Therapy (SIRT) (done in tandem with hepatic intraarterial procedure) - Y-90 based microsphere
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No.	MoH Hospitals	Category	Machines	Model	In-patient radionuclide ward
1.	Hospital Kuala Lumpur	Level 2s	SPECT-CT	Siemens SYMBIA T6	14 beds
			SPECT	Siemens Signature Duet	
			SPECT	Siemens Signature ECAM	
2.	Institut Kanser Negara / Hospital Putrajaya	Level 2sp	PET-CT	GE Discovery ST	28 beds
			Cyclotron	GE PET Trace 4	
			SPECT-CT	Philips Brightview XCT	
			SPECT	Philips Bright View	
3.	Hospital Pulau Pinang	Level 2sp	PET-CT	GE Discovery ST	5 beds
			SPECT	Siemens E-CAM Single Head	
			SPECT	Siemens Dual Head	
4.	Hospital Sultanah Aminah	Level 1s	SPECT	Siemens Symbia E	
5.	Hospital Umum Sarawak	Level 2s	SPECT	Philips Forte Jetstream AZ	1 beds
			SPECT	Siemens Dual Head	
6.	Hospital Wanita Dan Kanak-Kanak Sabah	Level 2s	SPECT	Philips Brightview X	5 beds

No.	University Hospitals & Govt.-link Institutions	Category	Machines	Model	In-patient radionuclide ward
1.	Pusat Perubatan Universiti Malaya	Level 2sp	PET-CT	Philips Gemini TF	4 beds
			SPECT-CT	Philips Brightview XCT	
			SPECT	PHILIPS Brightview	
			SPECT	PHILIPS IRIX PRISM 3000	
2.	Pusat Perubatan UKM	Level 1sp	PET-CT	GE Discovery 690	
			SPECT-CT	GE Inifinia Hawkeye 4	
3.	Hospital Universiti Sains Malaysia, USM	Level 2s	SPECT	Siemens Symbia E Single	4 beds
			SPECT	Philips Adac Forte	
4.	Pusat Pengimejan Diagnostik Nuklear UPM	Level 1p	PET-CT	Siemens Biograph 64 True Point	
5.	Institut Perubatan Dan Pergigian Termaju, USM	Level 2s	SPECT-CT	GE Discovery NM/CT 670	3 beds
6.	Kulliyyah Of Medicine, UIA	Level 1s	SPECT	GE Infinia	
7.	Institut Jantung Negara	Level 1s	SPECT	GE VENTRI	
			SPECT	GE VENTRI	

No.	Private Hospitals or Institutions	Category	Machines	Model	In-patient radionuclide ward
1.	Sime Darby Medical Centre Subang Jaya Sdn. Bhd.	Level 2sp	PET-CT	GE Discovery VCT	4 beds
			SPECT	Siemens E.CAM TM Signatura Series	
2.	Beacon International Specialist Centre Sdn. Bhd.	Level 1p	PET-CT	Siemens Somatom Emotion Duo-Power	
			Cyclotron	Siemens Eclipse HP	
3.	Prince Court Medical Centre Sdn.Bhd.	Level 1sp	PET-CT	Siemens Biograph 6	
			SPECT	Philips Forte Jetstream AZ	
4.	Austral Euro Diagnosis Sdn Bhd – KL	Level 1p	PET-CT	GE Discovery STE 16	
5.	Austral Euro Diagnosis Sdn Bhd – JB	Level 1p	PET-CT	GE Discovery STE 16	
6.	Loh Guan Lye Specialist Centre	Level 1p	PET-CT	Siemens Biograph 40 Truepoint	
7.	Penang Adventist Hospital	Level 1p	PET-CT	GE Discovery STE	
8.	Mount Miriam Cancer Hospital	Level 1p	PET-CT	GE Discovery STE 16	
9.	KPJ Johor Specialist Hospital	Level 1p	PET-CT	GE Discovery PET/CT 610	
10.	The National Cancer Society Of Malaysia	Level 1s	SPECT	GE Infinia	

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Strength:

Established, fixed identity

Root of authority

Weakness:

Hardware limitations (MoH hospitals)

High cost of setup & RP

Opportunities:

Selling the services

Threats:

Tug of war with Radiology

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Pharmaceutical Cold Kits or Radioisotopes	Manufacturer	RM	USD
Tetrafosmin (Myoview)	GE Healthcare, UK	4,385.00	1,096.25
Sestamibi (Stamicis)	Eczacibasi Monrol, Turkey	1,880.00	470.00
	IBA-Cis Bio, France	2,150.00	537.50
	Mallinkrodt Pharmaceuticals, Natherlands	3,725.00	931.25
Succimer Inj (DMSA)	Eczacibasi Monrol, Turkey	470.00	117.50
	IBA-Cis Bio, France	480.00	120.00
	Mallinkrodt Pharmaceuticals, Natherlands	929.00	232.25
Mertiatide Inj (MAG3)	Eczacibasi Monrol, Turkey	1,720.00	430.00
	ROP Rotop Pharmaceutical, Germany	1,830.00	457.50
	Mallinkrodt Pharmaceuticals, Natherlands	1,129.00	282.25
Pentetate Inj (DTPA)	Eczacibasi Monrol, Turkey	470.00	117.50
	IBA-Cis Bio, France	488.00	122.00
	Mallinkrodt Pharmaceuticals, Natherlands	532.00	133.00
Medronate Inj (MDP)	Eczacibasi Monrol, Turkey	470.00	117.50
	PHE Pharmaluscence, USA	900.00	225.00
Osteosis Inj (HDP)	IBA-Cis Bio, France	440.00	110.00
	Mallinkrodt Pharmaceuticals, Natherlands	484.00	121.00
Mebrofenin Inj (Hibida)	GE Healthcare, UK	1,040.00	260.00
Sulphur Colloid Inj	PHE Pharmaluscence, USA	4,750.00	1,187.50
Nanocolloid Inj (Nanocoll)	GE Healthcare, UK	2,150.00	537.50
Tc-99m Generator (800mCi)	IBA-Cis Bio, France	6,985.00	1,746.25
I-131 capsule (15mCi)	GE Healthcare, UK	1,520.00	380.00

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Following are the target set for each center in the future development of this field under MoH:

NUCLEAR MEDICINE CENTRES		GOALS AND NEW POLICIES
<u>Northern Region:</u>		
Hospital Pulau Pinang		<ul style="list-style-type: none"> To replace the old condemned machine with a new unit of SPECT-CT machine
<u>Central Region:</u>		
i) Hospital Kuala Lumpur		<ul style="list-style-type: none"> To advance and upgrade the current radioisotope lab in order to fulfil “ Good Radiopharmacy Practices” To install a new PET-CT unit for the existing oncology services
ii) Institut Kanser Negara		<ul style="list-style-type: none"> To introduce the use of new targeted radionuclide therapies like PRRT and RIT To explore any new radiopharmaceutical substances used in oncology for diagnosis and/or therapy
<u>Southern Region:</u>		
Hospital Sultanah Aminah, Johor Baharu		<ul style="list-style-type: none"> To replace the old condemned machine with a new unit of cardiac dedicated SPECT machine To build a new building for Department of Nuclear Medicine and PET at Hospital Sultan Ismail
<u>East Malaysia, Sarawak:</u>		
Hospital Umum Sarawak		<ul style="list-style-type: none"> To replace the old condemned machine with a new unit of SPECT-CT machine To upgrade the current facility for radioiodine treatment To install a new PET-CT unit for the existing oncology services A Nuclear Medicine Center capable of providing Level 2sp service to this region shall be built at HUS. In case that there is a plan to build a comprehensive cancer centre in Sarawak, it is then sensible to incorporate the above Level 2sp nuclear medicine service into this plan rather than having a separated entity.
<u>East Malaysia, Sabah</u>		
Hospital Wanita & Kanak-Kanak Sabah		<ul style="list-style-type: none"> To expand the service provided by the new Nuclear Medicine Department To install a PET-CT unit for the oncology services
<u>East Coast, Peninsular</u>		
<ul style="list-style-type: none"> A new Nuclear Medicine Centre for the east coast region of the peninsular Malaysia, probably at the state of Terengganu 		
<u>Towards a wholesome multidisciplinary approach in cancer management</u>		
<ul style="list-style-type: none"> All new oncology centres should be equipped with a Nuclear Medicine facility of at least Level 1sp 		
<u>To make it available, accessible and affordable to patients who need its service</u>		
<ul style="list-style-type: none"> All other tertiary state hospitals having the following disciplines should have a Nuclear Medicine facility of at least Level 1s. <ul style="list-style-type: none"> - internal medicine / cardiology - paediatric - nephrourology 		

Current Radionuclide Therapies	Radiopharmaceutical
<p><u>Oncology</u></p> <ul style="list-style-type: none"> –Thyroid cancer –Painful bone metastases –Hepatic metastases –Neuroendocrine tumours 	<p>I-131 Sodium iodide P-32 Sodium ortho-phosphate, Sr-89 Strontium chloride, Sm-152 Lexionam <u>SIRT with:</u> Y-90 Microspheres I-131 lipiodol <u>PRRT with:</u> In-111 Octreotide, Y-90 DOTATOC, Y-90 DOTATATE, Lu-177 DOTATATE I-131 MIBG</p>
<p><u>Endocrine</u></p> <ul style="list-style-type: none"> –Hyperthyroidism 	<p>I-131 Sodium iodide</p>
<p><u>Hematology</u></p> <ul style="list-style-type: none"> –Non-Hodgkin's Lymphoma –Polycythemia vera 	<p><u>RIT with:</u> I-131 Rituximab, Y-90 Ibritumomab P-32 phosphate</p>
<p><u>Rheumatology</u></p> <ul style="list-style-type: none"> –Arthritis 	<p><u>RIT with:</u> Y-90 P-32 Re-186</p>

Thank you

