

Specialty Training Requirements (STR)

Name of Specialty:	Nuclear Medicine
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Note: In addition to the training requirements stated in this STR, residents must comply with any other regulatory requirements or practice-based requirements mandated by the healthcare institutions or place of practice.

Scope of Nuclear Medicine

Nuclear Medicine (NM) is an established and rapidly evolving specialty that has become increasingly important in clinical patient management in the current era of precision medicine. NM uses radiopharmaceuticals, to evaluate molecular, metabolic, physiologic and pathologic conditions of the body for the purposes of diagnosis, therapy and research.

Purpose of the Residency Programme

The purpose of the NM Residency Programme is to produce NM specialists who are competent and proficient to practice NM with professionalism and high clinical quality. This will involve all aspects of NM including performance and reporting of diagnostic NM scans and NM therapeutic procedures.

Admission Requirements

At the point of application for this residency programme,

- a) Applicants must be employed by employers endorsed by Ministry of Health (MOH), and
- b) Residents who wish to switch to this residency programme must have waited at least one year between resignation from his/her previous residency programme and application for this residency programme.

At the point of entry to this residency programme, residents must have fulfilled the following requirements:

- c) Have completed local Internal Medicine Residency programme and attained the MRCP (UK) and/or Master of Medicine (Internal Medicine) (NUS) qualifications or equivalent; or have completed the local Diagnostic Radiology Residency Programme (4 years) and attain FRCR and/or Master of Medicine (Diagnostic Radiology) (NUS) qualifications or equivalent. Potential residents without these qualifications will need to seek ratification from JCST before they can be considered for the programme; and
- d) Have a valid Conditional or Full Registration with Singapore Medical Council (SMC).

Selection Procedures

Applicants must apply for the programme through the annual residency intake matching exercise conducted by Ministry of Health Holdings (MOHH).

Continuity plan: Selection should be conducted via a virtual platform in the event of a protracted outbreak whereby face-to-face on-site meeting is disallowed and cross institution movement is restricted.

DR RAC will interview DR candidates applying for dual-accreditation after the candidates have completed 48 months of DR residency, and recommends suitable candidates to NM RAC. NM RAC will then conduct its interview and provides input to the NM Residency Programme Directors (PDs). This is to ensure that the candidate being admitted to dual-training are competent and ready to take on the longer period of training.

Less Than Full Time Training

Less than full time training is not allowed.

Non-traditional Training Route

The programme should only consider the application for mid-stream entry to residency training by an International Medical Graduates (IMG) if he/she meets the following criteria:

- a) He/she is an existing resident or specialist trainee in the United States, Australia, New Zealand, Canada, United Kingdom and Hong Kong, or in other centres/countries where training may be recognised by the Specialist Accreditation Board (SAB)
- b) His/her years of training are assessed to be equivalent to the local training by JCST and/or SAB.

Applicants may enter residency training at the appropriate year of training as determined by the Programme Director and RAC.. The latest point of entry into residency for these applicants is Year 1 of the senior residency phase.

Note: Entering at Year 1 of the senior residency phase by IMG in any of the IM-related programmes is regarded as 'mid-stream entry' because it requires the recognition of the overseas Junior Residency training.

NM RAC will review the application by foreign-trained doctors on a case-by-case basis, with inputs from DR/IM RAC on the recognition of DR/IM residency equivalent posting(s). The applicant(s) would need to fulfil the outstanding postings (if any) and submit documentations for NM RAC and DR/IM RAC for reviews. Applicants are required to fulfil the posting requirements before they are allowed to start NM residency training (subject to matching).

Separation

The PD must verify residency training for all residents within 30 days from the point of notification for residents' separation / exit, including residents who did not complete the programme.

Duration of Specialty Training

The training duration must be 36 months in IM junior residency and 30 months in Nuclear Medicine senior residency; or 48 months in DR residency and 30 months in Nuclear Medicine senior residency under the Dual Accreditation framework of Diagnostic Radiology and Nuclear Medicine.

Maximum candidature: All residents must complete the training requirements, requisite examinations and obtain their exit certification from JCST not more than 36 months beyond the usual length of their training programme. The total candidature for NM residency is 36 months Internal Medicine residency + 30 months NM residency + 36 months candidature, or 48 months DR residency + 30 months NM residency + 36 months candidature.

Nomenclature: NM residents will be denoted by SR1, SR2 and SR3 according to their residency year of training.

“Make-up” Training

“Make-up” training must be arranged when residents:

- Exceed days of allowable leave of absence / duration away from training or
- Fail to make satisfactory progress in training.

The duration of make-up training should be decided by the Clinical Competency Committee (CCC) and should depend on the duration away from training and/or the time deemed necessary for remediation in areas of deficiency. The CCC should review residents’ progress at the end of the “make-up” training period and decide if further training is needed.

Any shortfall in core training requirements must be made up by the stipulated training year and/or before completion of residency training.

Learning Outcomes: Entrustable Professional Activities (EPAs)

Residents must achieve level 4 of the following EPAs by the end of residency training:

	Title
EPA 1	Managing patients referred for radionuclide therapy
EPA 2	Conducting NM diagnostic studies
EPA 3	Handling unsealed radioactive sources
EPA 4	Conducting nuclear cardiology stress test
EPA 5	Educating patients, allied health professionals, residents and peers about NM and radiation safety

Learning Outcomes: Core Competencies, Sub-competencies and Milestones

The programme must integrate the following competencies into the curriculum, and structure the curriculum to support resident attainment of these competencies in the local context.

Residents must demonstrate the following core competencies:

1) Patient Care and Procedural Skills

Residents must demonstrate the ability to:

- Gather essential and accurate information about the patient
- Counsel patients and family members
- Make informed diagnostic and therapeutic decisions
- Prescribe and perform essential medical procedures
- Provide effective, compassionate and appropriate health management, maintenance, and prevention guidance

Residents must demonstrate the ability in:

- 1.1 Including pertinent patient information relevant to the requested procedure using patient interview, chart and computer data base review, the performance of a focused physical examination as indicated, and communication with the referring physician
- 1.2 Recommending, selecting, planning, conducting, supervising, interpreting, and reporting diagnostic and therapeutic NM procedures appropriate for the clinical problem and patient's condition
- 1.3 Correlating the NM procedure with clinical information, laboratory, and other procedural or imaging studies
- 1.4 Selection of the appropriate radiopharmaceutical, dose, imaging technique, data analysis, basic supervisory skills, image presentation, and interpretation in the performance of parathyroid, gastrointestinal, infection, pulmonary, urinary tract procedures, and PET/CT studies and other NM Imaging procedures; including:
 - 1.4.1 Musculoskeletal studies for benign and malignant disease
 - 1.4.2 Endocrinological studies, including thyroid and parathyroid. Thyroid studies must include measurement of iodine uptake and dosimetry calculations for radioiodine therapy
 - 1.4.3 Gastrointestinal studies, including transit studies, liver and hepatobiliary, bleeding, and Meckel's diverticulum
 - 1.4.4 Infection studies, including gallium, labelled leukocytes, and bone marrow imaging

- 1.4.5 Oncology studies, including sentinel node localisation, fluorodeoxyglucose (FDG), adrenal, somatostatin-receptor imaging and other agents as they become available
- 1.4.6 Neurological studies, including cerebral perfusion, cerebral metabolism and cerebrospinal fluid. This should include studies of dementia, epilepsy, and brain death
- 1.4.7 Pulmonary studies, including perfusion and ventilation for pulmonary embolus, right-to left shunts, and quantitative assessment of perfusion and ventilation
- 1.4.8 Urinary tract studies, including renal perfusion, function and cortical imaging, renal scintigraphy with pharmacologic interventions, and renal transplant evaluation
- 1.4.9 Cross-sectional imaging of the brain, head and neck, thorax, abdomen, and pelvis with computed tomography (CT) in the context of single photon emission computed tomography – computed tomography (SPECT)/CT and positron emission tomography–computed tomography (PET/CT)
- 1.4.10 Myocardial perfusion imaging with treadmill and pharmacologic stress, including patient monitoring, with special emphasis on electrocardiographic interpretation
- 1.4.11 Electrocardiogram (ECG)-gated ventriculography for evaluation of ventricular performance
- 1.5 Interpretation of PET/CT studies performed for oncological and non-oncologic indications
- 1.6 Preparation of radiopharmaceuticals, including preparing patient doses and performing quality control measures
- 1.7 Therapeutic administration of radiopharmaceuticals as part of radionuclide therapies such as radioiodine therapy for thyrotoxicosis and thyroid cancer, radionuclide peptide receptor therapy, radioligand therapies, including patient consultation, patient selection, evaluating risks and benefits, determining the administered dose, patient identity verification, obtaining informed consent, documenting pregnancy status, using administrative controls to prevent a medical event, complying with national regulations regarding the medical use of radiopharmaceuticals, counselling patients and their families about radiation safety issues, and scheduling and performing post-therapy follow-up
- 1.8 ward management of patients and outpatient management of patients for therapeutic or theranostic NM, including safety and quality issues and management of complications and side-effects arising from such therapies

2) Medical Knowledge

Residents must demonstrate knowledge of established and evolving biomedical, clinical, epidemiological and social-behavioural sciences, as well as the application of this knowledge to patient care.

Residents must demonstrate knowledge in:

1. General NM (with cross sectional anatomy)
2. Nuclear cardiology
3. Therapeutic NM
4. PET (with cross sectional anatomy)
5. NM basic Physics
6. Radiopharmacy

3) System based practice

Residents must demonstrate the ability to:

- Work effectively in various health care delivery settings and systems relevant to their clinical specialty
- Coordinate patient care within the health care system relevant to their clinical specialty
- Incorporate considerations of cost awareness and risk/benefit analysis in patient care
- Advocate for quality patient care and optimal patient care systems
- Work in inter-professional teams to enhance patient safety and improve patient care quality. This includes effective transitions of patient care and structured patient hand-off processes.
- Participate in identifying systems errors and in implementing potential systems solutions

4) Practice based learning and Improvement

Residents must demonstrate a commitment to lifelong learning.

Resident must demonstrate the ability to:

- Investigate and evaluate patient care practices
- Appraise and assimilate scientific evidence
- Improve the practice of medicine
- Identify and perform appropriate learning activities based on learning needs

5) Professionalism

Residents must demonstrate a commitment to professionalism and adherence to ethical principles including the SMC's Ethical Code and Ethical Guidelines (ECEG).

Residents must:

- Demonstrate professional conduct and accountability
- Demonstrate humanism and cultural proficiency
- Maintain emotional, physical and mental health, and pursue continual personal

- and professional growth
- Demonstrate an understanding of medical ethics and law

6) Interpersonal and Communication skills

Residents must demonstrate ability to:

- Effectively exchange information with patients, their families and professional associates.
- Create and sustain a therapeutic relationship with patients and families
- Work effectively as a member or leader of a health care team
- Maintain accurate medical records

Other Competency: Teaching and Supervisory Skills

Residents must demonstrate ability to:

- Teach others
- Supervise others

Learning Outcomes: Others

Residents must attend Medical Ethics, Professionalism and Health Law course conducted by Singapore Medical Association.

Curriculum

The curriculum and detailed syllabus relevant for local practice must be made available in the Residency Programme Handbook and given to the residents at the start of each posting.

The PD must provide clear goals and objectives for each component of clinical experience.

Learning Methods and Approaches: Scheduled Didactic and Classroom Sessions

The core curriculum must include a didactic programme based on the core knowledge content of NM:

1. General NM (with cross sectional anatomy)
2. Nuclear cardiology
3. Therapeutic NM
4. PET (with cross sectional anatomy)
5. NM basic Physics
6. Radiopharmacy

The programme must provide opportunities for residents to interact with other residents and faculty members in educational sessions at a frequency sufficient for peer-peer and peer-faculty member interaction.

Patient-based teaching must include direct interaction between residents and attending physicians, discussion of pathophysiology, and the use of current evidence

in diagnostic and therapeutic decisions. Teaching must be:

1. Formally conducted on all inpatient and consultative services; and,
2. Conducted with a frequency and duration sufficient to ensure a meaningful and continuous teaching relationship between the assigned teaching attending and resident.

The programme must provide the following teaching sessions that the residents are required to attend.

Residents must attend a minimum of 75% of all described sessions below:

Type	Minimum Frequency	Learning Outcomes
Journal Club	Once a month	• Nurture an enquiring mind. • Appraise and critique a publication. • Apply the practice of evidence- based medicine.
Tumour boards	Once a month	• Provide NM opinion on diagnosis, interventional and management of patient based on evidence-based medicine and best practices. • Understands the role of MDT in co-operative decision making, and the roles and responsibilities of various healthcare professionals. • Considers and rationalises the input of other healthcare professionals and acts on it as appropriate.
NM Didactic Teaching programme	Weekly	Residents should demonstrate competence in their knowledge of all topics included in the didactic curriculum.
Case conference/Peer Review Learning-Quality Assurance Committee meeting	Weekly	Demonstrate basic knowledge in clinical indications, general procedures and scintigraphic findings in NM procedures and therapy.
Case Therapy Teaching Session	Every 2 monthly	Apply knowledge in the therapeutic administration of radiopharmaceuticals, including patient selection, evaluating risks and benefits, determining the administered dose.

Learning Methods and Approaches: Clinical Experiences

Residents must have the following rotations:

	Residents (IM track)	Residents (DR track)
General NM (SGH)	7 months	7.5 months
Radiopharmacy (SGH)	1 month	1 month
Therapeutic NM (SGH)	5 months	8 months
PET/CT (SGH)	5 months	6 months *
Nuclear Cardiology (NHCS)	1 month	1.5 months
Cross-sectional Imaging (SGH/NCCS)	5 months	Nil
Small animal imaging (SEMC)	0.5 month	0.5 month
NM Physics & NM Radiology	2.5 months	2.5 months
NM (NUHS)	3 months	3 months

*Maximum 1 month of this posting can be replaced with an elective DR posting, subject to PD's approval

In the event of a protracted outbreak, whereby face-to-face on-site meetings are disallowed, and cross institution movement is restricted, all residents should do their postings in the parent institution (primary site of the Senior Residency).

Learning Methods and Approaches: Scholarly/Teaching Activities

Residents must demonstrate:

- Ability to do literature survey, analysis of published research paper, formulate research hypothesis, conduct research and publish research paper; and
- Ability to identify quality issue and participate in Quality Improvement projects.

Residents must achieve the following scholarly activities by the end of residency:

1. At least 1 poster/oral presentation at a local/overseas conference, or first author publication/acceptance of paper for a NM related topic
2. Completion of a Quality Improvement project

Learning Methods and Approaches: Documentation of Learning

Residents must report and log a minimum total number of 2500 procedures by the end of residency:

Procedures	Minimum number
Central Nervous System	10
Skeletal System	600
Cardiovascular system	300
Pulmonary System	50
Gastrointestinal System	50
Urogenital System	100
Endocrine system	300
Haemopoietic and lymphatic system	50
Infection and inflammation	30
Oncology imaging (including PET/CT)	400
Radionuclide therapy-benign	100
Radionuclide therapy malignancy	30
Other radionuclide treatment	10
Paediatric NM procedure	20 per year
T examinations	600

Summative Assessments

For AY2024 intake onwards

	Internal Medicine Track	
	Summative Assessments	
NM Senior Residency	SR3	1. Rapid Reporting – 20 cases, 2 mins per film (total: 40 mins) 2. Film Viewing with viva voce on General Nuclear Medicine Imaging and PET Imaging – 3 films per examiner, 15 mins each (total: 3 examiners, 45 mins) 3. Viva voce – 2 stations, 20 mins per station (total: 40 mins) 4. Attainment of entrustment levels for EPAs

	SR2	MCQ Examination (Single Best Answer) – 100 questions, Duration: 2.5 hours (150 mins)
	SR1	Nil
IM Residency (junior)	R3	Joint Final M.Med (Internal Medicine)/ MRCP Part 2 Written and PACES
	R2	
	R1	Joint Primary M.Med (Internal Medicine)/ MRCP Part 1

		Diagnostic Radiology Track
NM Residency		Summative
	SR3	1. Rapid Reporting – 20 cases, 2 mins per film (total: 40 mins) 2. Film Viewing with viva voce on General Nuclear Medicine Imaging and PET Imaging – 3 films per examiner, 15 mins each (total: 3 examiners, 45 mins) 3. Viva voce – 2 stations, 20 mins per station (total: 40 mins) 4. Attainment of entrustment levels for EPAs
	SR2	MCQ Examination (Single Best Answer) – 100 questions, Duration: 2.5 hours (150 mins)
	SR1	Nil
DR Residency	R4	Final M.Med (DR)/ FRCR Part 2B
	R3	FRCR Part 1 and FRCR Part 2A
	R2	
	R1	

For AY2023 intake and before

	Internal Medicine Track	
	Summative Assessments	
NM Senior Residency	SR3	1. MCQs (True/False) 2. Rapid Reporting 3. Film Viewing –Viva on General NM Imaging and Molecular/PET Imaging
	SR2	Nil
	SR1	Nil

IM Residency (junior)	R3	Joint Final M.Med (Internal Medicine)/ MRCP Part 2 Written and PACES
	R2	
	R1	Joint Primary M.Med (Internal Medicine)/ MRCP Part 1

		Diagnostic Radiology Track
NM Residency		Summative
	SR3	1. MCQs (True/False) 2. Rapid Reporting 3. Film Viewing –Viva on General NM Imaging and Molecular/PET Imaging
	SR2	Nil
	SR1	Nil
DR Residency	R4	Final M.Med (DR)/ FRCR Part 2B
	R3	FRCR Part 1 and FRCR Part 2A
	R2	
	R1	

S/N	<u>Learning outcomes</u>	Summative assessment components			
		Component a: MCQ	Component b: Rapid reporting	Component c: Film viewing	Component d: Viva
1	Patient Care	✓		✓	✓
2	Medical Knowledge	✓	✓	✓	✓
3	Practice-based Learning and Improvement		✓	✓	✓
4	Interpersonal and Communication Skills				✓
5	Professionalism				✓
6	Systems-based Practice				✓
7	Faculty Development	-	-	-	-