UNION EUROPÉENNE DES MÉDECINS SPÉCIALISTES
EUROPEAN UNION OF MEDICAL SPECIALISTS

Association internationale sans but lucratif — *International non-profit organisation*

EU Transparency Register 219038730914-92 — VAT BE 0469.067.848
Rue de l'Industrie, 24 - BE-1040 Brussels — T +32 2 649 51 64
www.uems.eu — info@uems.eu

Training Requirements for the Specialty of Nuclear Medicine

European Standards of Postgraduate Medical Specialist Training

(Old chapter 6)

Preamble

The UEMS is a non-governmental organisation representing national associations of medical specialists at the European Level. With a current membership of 37 national associations and operating through 43 Specialist Sections and European Boards, the UEMS is committed to promote the free movement of medical specialists across Europe while ensuring the highest level of training which will pave the way to the improvement of quality of care for the benefit of all European citizens. The UEMS areas of expertise notably encompass Continuing Medical Education, Post Graduate Training and Quality Assurance.

It is the UEMS' conviction that the quality of medical care and expertise is directly linked to the quality of training provided to the medical professionals. Therefore, the UEMS committed itself to contribute to the improvement of medical training at the European level through the development of European Standards in the different medical disciplines. No matter where doctors are trained, they should have at least the same core competencies.

In 1994, the UEMS adopted its Charter on Post Graduate Training aiming at providing the recommendations at the European level for good medical training. Made up of six chapters, this Charter set the basis for the European approach in the field of Post Graduate Training. With five chapters being common to all specialties, this Charter provided a sixth chapter, known as “Chapter 6”, that each Specialist Section was to complete according to the specific needs of their discipline.

More than a decade after the introduction of this Charter, the UEMS Specialist Sections and European Boards have continued working on developing these European Standards in Medical training that reflects modern medical practice and current scientific findings. In doing so, the UEMS Specialist Sections and European Boards did not aim to supersede the National Authorities' competence in defining the content of postgraduate training in their own State but rather to complement these and ensure that high quality training is provided across Europe.

At the European level, the legal mechanism ensuring the free movement of doctors through the recognition of their qualifications was established back in the 1970s by the European Union. Sectorial Directives were adopted and one Directive addressed specifically the issue of medical Training at the European level. However, in 2005, the European Commission proposed to the European Parliament and Council to have a unique legal framework for the recognition of the Professional Qualifications to facilitate and improve the mobility of all workers throughout Europe. This Directive 2005/36/EC established the mechanism of automatic mutual recognition of qualifications for medical doctors according to training requirements within all Member States; this is based on the length of training in the Specialty and the title of qualification.

Given the long-standing experience of UEMS Specialist Sections and European Boards on the one hand and the European legal framework enabling Medical Specialists and Trainees to move from one country to another on the other hand, the UEMS is uniquely in position to provide specialty-based recommendations. The UEMS values professional competence as "the habitual and judicious use of communication, knowledge, technical skills, clinical reasoning, emotions, values, and reflection in daily practice for the benefit of the individual and community being served". While professional activity is regulated by national law in EU Member States, it is the UEMS understanding that it has to comply with International treaties and UN declarations on Human Rights as well as the WMA International Code of Medical Ethics.

This document derives from the previous Chapter 6 of the Training Charter and provides definitions of specialist competencies and procedures as well as how to document and assess them. For the sake of transparency and coherence, it has been renamed as "Training Requirements for the Specialty of X". This document aims to provide the basic Training Requirements for each specialty and should be regularly updated by UEMS Specialist Sections and European Boards to reflect scientific and medical progress. The three-part structure of this documents reflects the UEMS approach to have a coherent pragmatic document not only for medical specialists but also for decision-makers at the National and European level interested in knowing more about medical specialist training.

Nuclear Medicine is a branch of medicine that uses unsealed radioactive substances for diagnosis and therapy. These substances are used to investigate disorders of metabolism and function most often at molecular level, under physiological and physiopathological conditions. The procedures within the scope of this definition include *in vivo* imaging with radiopharmaceuticals, correlative/multimodality imaging, radionuclide-guided surgery, dosimetry, therapy with radiopharmaceuticals and implantable medical devices such as radiolabeled microspheres, techniques related to nuclear physics in medicine, as well as the medical applications of radiobiology, *in vitro* procedures and radiation protection.

The aim and scope of this document are to define the high standard provided for training nuclear medicine specialists throughout EU. These guidelines are aimed at trainees, trainers and training institutions, as well as national legislation and directives. A standardized training in nuclear medicine throughout EU is a prerequisite for free movement of specialist within EU.

This document will be revised every five years.

Table of acronyms

CT: Computed Tomography

DXA: Dual energy X-ray absorption

EANM: European Association of Nuclear Medicine

EBNM: European Board of Nuclear Medicine

ECG: electrocardiogram

FPRNA: First-pass radionuclide angiography

FDOPA: L-6-[^{18}F] fluoro-3,4-dihydroxyphenylalnine

[^{18}F]FDG: 2-deoxy-2-[^{18}F]fluoro-D-glucose

[^{18}F]NaF: [^{18}F]Sodium fluoride

GBPS: Gated blood-pool scintigraphy

MIBG: Meta-iodobenzylguanidine)

MUGA: Multigated acquisition scan

MRI: Magnetic Resonance Imaging

MRS: Magnetic Resonance Spectroscopy

NM: Nuclear Medicine

PET: Positron Emission Tomography

PSMA: Prostate-specific membrane Antigen

SPECT: Single Photon Emission Computed Tomography

US: Ultrasonography

V/Q: Ventilation/Perfusion scintigraphy

COMPETENCY

I. TRAINING REQUIREMENTS FOR TRAINEES

1. Content of training and learning outcome

A. Theoretical knowledge

A good general background in medicine (e.g. internal medicine, oncology, cardiology, endocrinology, surgery, etc.) is assumed. More detailed knowledge of those conditions which may need to be investigated or treated by NM techniques is required.
NM specialists also use complementary methods related to NM procedures. These include: ultrasound, ECG (including dynamic + pharmacological stress testing) and management of emergencies and adverse reactions, correlative/multimodality imaging methods, such as CT, MRI and MRS, laboratory assays, bone densitometry, other available techniques complementary to NM procedures, such as optical imaging.

NM specialists may cooperate in the assessment, prevention and treatment of physical or medical accidental contamination or incorporation of radionuclides.

Required theoretical knowledge comprises scientific principles, clinical nuclear medicine (NM) and integrative objectives:

a. Scientific principles relevant for nuclear medicine:

- Basic knowledge in physics, statistics, mathematics, computer science and artificial intelligence, including machine learning and deep learning
- Basic knowledge in biology (including molecular biology), physiology and physiopathology
- Nuclear physics & Radiation physics
- Radiobiology
- Radiochemistry
- Radiopharmacy
- Tracer kinetic modelling
- Dosimetry
- Radiation protection & radiation safety
- Instrumentation
- Data acquisition and image processing techniques, including SPECT, SPECT/CT, PET, PET/CT and PET/MRI
- Quantitative techniques in NM
- Principles of other imaging modalities including dual energy X ray absorption (DXA), ultrasound, CT, MRI, MRS & optical imaging.
- Principles of therapeutic modalities relevant to NM applications
- Quality assurance

b. Clinical NM:

- Applications of radiopharmaceuticals: indications, justification, prescription, administration, procedures/protocols and results, methodology and dosimetry;
- Diagnostic imaging:
  - Patterns of radiopharmaceutical uptake; normal and abnormal appearances of images, normal variants and common artifacts in images.
  - Cross-sectional anatomy - basic clinical CT and MRI including those findings requiring further action and comprehensive knowledge of hybrid imaging
  - Correlative imaging of NM images and those from other imaging techniques, including US.
  - Radionuclide-guided and bimodal-guided surgery techniques
  - External beam radiotherapy treatment planning using NM techniques
  - Types and applications of X-ray contrast materials and gadolinium chelates, contraindications of contrast agents and management of their adverse reaction, in the context of hybrid imaging.
- Therapeutic applications:
  - Methodology for targeted imaging and treatment.
  - Management of complications and side effects.

c. Integrative objectives:

- Obtain a pertinent history and perform an appropriate physical examination.
- Select the most appropriate nuclear medicine examination with the most appropriate radiopharmaceutical to address the clinical problem.
- Integrate and evaluate of the diagnostic findings with the clinical data and the results of other imaging procedures and laboratory results.
- Have a comprehensive knowledge of the diagnostic algorithms in clinical fields relevant to NM.
- Recommend further study or treatment as appropriate.
- Understand the importance of, and master the practice of structured and standardized reporting of nuclear medicine procedures.
- Actively contribute to multidisciplinary tumor boards and other clinical boards whenever relevant.
- Communicate effectively and promptly with patients and referring physicians in both written and verbal reports.
- Understand the basic principles of scientific research methodology including clinical trial design.
- Participate in lifelong education and development of new skills.
- Assume responsibility for patient management or be an active participant in the management team when nuclear medicine therapy is indicated.
- Apply programs for quality assurance and quality control
- Have knowledge of the overall organization and management of a NM department.

d. Development, new trends and research:

- Continued medical education in order to gain/maintain familiarity with new targets for molecular imaging and therapy.
- Methodological developments in imaging techniques such as optical bioluminescence and fluorescence imaging
- Regulatory requirements for clinical translation of new molecular imaging agents.

Practical and clinical skills

Dedicated training in medical oncology is highly recommended. Training in other specialties is also required during NM training, for example radiation oncology, cardiology, endocrinology, neurology, etc. The proportion of the total training period devoted to clinical training in other specialties may vary according to several factors, amongst them the total length of the training.

Dedicated training in cross-sectional imaging using CT and MRI is highly recommended.

Trainees are obliged to play an active in-service role in the practice of NM in order to familiarize themselves with all the techniques required from a NM practitioner, such as:

Protocols of diagnostic and therapeutic procedures;

Data acquisition and processing with various types of equipment, quality control of instruments and labeled agents;

Interventional procedures, including physiological, pharmacological related to diagnostic applications, and therapy;

At the end of the training program, trainees must be able to plan, perform, process, analyze report and archive any type of nuclear medicine diagnostic procedure *in vivo* related to oncology, inflammatory and infectious diseases and the exploration of the diseases related to the following:

Central nervous system and psychiatry

Bone and joints

Cardiovascular system

Respiratory system

Gastrointestinal system

Nephro-urinary and genital system

Endocrine system

Haematopoietic and lymphatic system

Training should include initial evaluation for indication, justification, administration, and therapeutic applications of radiopharmaceuticals and administrable or implantable medical devices, dosimetry, radiation protection and follow-up after therapy.

The trainee must complete a minimum of 3000 documented diagnostic procedures. The minimum recommended number for each procedure is as follows:

Oncology	1000 (80% at least PET/CT)
Bone and joint	500 (50% at least SPECT or SPECT/CT)
Cardiovascular	500
Endocrinology	300
Neurology	250
Respiratory system	100 (50% combined V/Q)
Others including Urinary and GI track	350

It is recommended that at least 150 procedures have been performed in pediatric patients. Some flexibility may be accepted, but a broad-spectrum of most currently used procedures has to be covered. This list will be subject to periodic revision. It is strongly recommended that a period of training is spent away from the main department in at least one other recognized training centre.

Therapeutic applications in benign and malignant conditions should cover the following:

Patient selection, including the diagnostic procedures necessary to establish the need for and safety of radionuclide therapy, the indications and contraindications for the use of radionuclide therapeutic procedures, and the effectiveness of these procedures in relation to other therapeutic approaches.

Absorbed radiation dose, including calculation of dose to the target area, to the surrounding tissue, to other organ systems including critical organs, and to the total body.

Patient care during radionuclide therapy, including understanding potential early and late adverse reactions, additive toxicity when combined with other therapy, the timing and parameters of anticipated response, and follow-up and evaluation.

Potential adverse effects of radiation, including carcinogenic, teratogenic, and mutagenic effects and doses to family members and to the general population.

The trainee must take part in at least 100 therapeutic procedures.

B. ***Competences***

The trainee should be prepared to the basic responsibilities of a nuclear medicine specialist.
The trainee should have received education in the management of nuclear medicine services and cost-effectiveness of the nuclear medicine procedures.
The trainee must acquire regulatory expertise in health care problems related to unsealed radionuclide sources.
The trainee should be familiarized with research methods and evaluation, including critical reading of medical and scientific literature.

Further practice and experience of techniques should also be learned in this training period:

- Ethics.
- Legal and regulatory requirements including telemedicine when relevant.
- Regulations related to the transportation, storage, disposal and use of radioactive material
- Clinical audit including Quality Control and Quality Assurance.
- Health care management.
- Teaching and training.

C. ***Attitude***

1. Towards patients and accompanying persons or care givers
   a. Establish relationships with patients based on understanding, trust, respect, honesty and empathy with confidentiality
   b. Providing information related to the preparation before the procedures, and to the procedures themselves
   c. Evaluating patients through a thorough and appropriate examination
   d. Delivering information effectively and sensitively regarding serious issues, such as diagnosis or progression of cancer
   e. Giving information about discharging and post-procedural precautions including environmental radiation protection

2. Collaboration with physics and radiopharmacy staff
   a. Actively contribute to treatment planning and dosimetry along with medical physics experts
   b. Actively contribute to promote good practice in radiopharmaceutical handling, along with radiopharmacy staff

3. Collaboration with clinical staff in different departments
   a. Objectively describing the role of nuclear medicine imaging and therapeutic approaches in clinical decision making
   b. Approach to multidisciplinary diagnostic and treatment plans with the other members of the team

   c. Decision making and problem solving, skills to resolve misunderstandings and conflicts with and between the members of the team
4. Organisation
   a. Learning the operation of hospital management and administration
   b. Finding access to hospital resources in problem solving
   c. Seeking immediate solutions in emergency situations
5. Social, ethical and legal issues
   a. Knowing good clinical practice guidelines
   b. Being familiar with the ethical standards, human and animal rights to conduct clinical trials or studies
   c. Keeping informed and up to date about the national health policies, procedural guidelines, regulations and laws
   d. Having information about medicolegal issues

2. Organisation of training

A. Schedule of training

The period of training should be a minimum of four and preferably five calendar years. This training includes specific nuclear medicine training and training in other specialties. Any candidate who fulfilled the requirements of the NM training program is granted access to the specialty.

B. Curriculum of training

See Appendix 1

C. Assessment and evaluation

The quality of the entire training has to be objectively assessed after satisfactory completion of a minimum number of courses and/or workshops and a formally organized and controlled practical training. Each training program should contain a standard against which the progress of the trainee can be assessed for each element of the syllabus.
Trainees must pass qualification tests that cover both theoretical knowledge and practical abilities in the day-to-day practice of Nuclear Medicine. A board or similar form of academic or national authority will award a certificate. It will be based upon:

- Validation of the practical training (number of diagnostic and therapeutic procedures performed) and

- Final examination (covering basic science and clinical knowledge) on national/regional/local basis and/or
- Satisfactory completion of accredited, regional or national (international) courses or workshops in different fields (physics etc.) and/or
- Regular evaluation of skill and progress by an accredited trainer/supervisor

Successful trainees are awarded with a final certificate, degree or diploma that is recognized by the government. The EBNM examinations may serve as a good alternative to national board examination.

D. Governance

Each National Authority should work with the national scientific society for Nuclear Medicine to provide quality assurance of training in Nuclear Medicine. Trainees should have the opportunity to be partly trained in recognized training institutions both in other member states of the EU as well as outside the EU. These training periods and training institutions have to be approved by the National Authority.

The UEMS-EBNM fellowship exam could become a standard European exam as a standardized written and oral exam to obtain together with the curriculum and national approval conditions the title of a Specialist in Nuclear Medicine. Trainees will be supported at a number of levels. A trainee's clinical work will be supervised by a trainer, who will be responsible for providing the trainee with regular feedback. The training programs will be led in an institution or in a network of allied institutions by a program director. A trainee will meet their program director on a regular basis, i.e. every six months, to discuss their work, accompanied by documented evidence of clinical engagement and achievement of their learning and training outcomes. It is recommended that a portfolio is made for each trainee with the evaluations and appraisals that are carried out during the learning process.

II. TRAINING REQUIREMENTS FOR TRAINERS

1. Process for recognition as trainer

A. Requested qualification and experience

Trainers should have a minimum experience of 3 years in the practice of nuclear medicine and must be recognized as nuclear medicine specialist by its national accreditation body.

B. Core competencies for trainers

The trainers should be competent and accredited in all aspects described in Chapter I.
Trainers should justify their capabilities to oversee the trainees. They should provide the environment for the trainee to complete the specialty requirements in a progressive manner, i.e. adapt the trainee's responsibilities progressively to his/her progression.
The trainers should demonstrate their capability to assess the evolution of the trainees on a regular and formal basis, through regular interviews and/or evaluations.
The trainers should be able to organize the training center in such a way as the appropriate training environment is met. The trainers will have their job description agreed with their employer which will allow them sufficient time for support of trainees. The number of trainees would determine the amount of time each week that would be allocated to their support.

2. Quality management for trainers

Trainers should demonstrate that they maintain regularly their medical knowledge of the specialty, through continuing education, attending meetings etc.
Developing and validating innovative training methods is encouraged.
The trainers should be active participants in clinical research or at least be up to date regarding the major fields of research in nuclear medicine.
Trainers should encourage the trainees to participate in research related to the specialty.
Trainers will collaborate with trainees and their institution to evaluate the quality the training, and take all measures necessary to optimize it. Feedback from trainees will assist in this regard. The educational work of trainers will be appraised typically on no less that an annual basis within their Department/Institution as local circumstances determines. Educational support of trainers will be provided by their Department and Institution and through the Section and Board of Nuclear Medicine of UEMS.

III. TRAINING REQUIREMENTS FOR TRAINING INSTITUTIONS

1. Process for recognition as training centre

A. Requirement on staff and clinical activities

Training in nuclear medicine should be based in a university department, a university-affiliated institution or in a facility with an equivalent educational, and/or research programme, with the full complement of medical, surgical, and diagnostic services associated with a University Hospital. Training centres should be both nationally accredited and capable of fulfilling the quantitative criteria presented in the section Training Requirements for Trainees of the present document, in particular the number of therapeutic and diagnostic procedures

Rotations- Training Centres and One-Centre Training
Training Centres may be recognized to be of such quality as to provide sufficient training for the total period of specialty nuclear medicine training. Some centres, with high quality nuclear medicine clinical facilities and training, may lack the full complement of training facilities and opportunities. These centres may be recognized as a Rotation Training Centre of sufficient merit such that a trainee will receive sufficient training for part of the programme. A trainee may therefore fulfil the programme of training by rotating between a number of recognized training centres.

B. Requirement on equipment, accommodation

It is expected that training institutions operate all equipment, e.g., SPECT, SPECT/CT, PET/CT as per required to fulfil the requirements described in Chapter I. The same is true for therapeutic procedures that may require in-hospital stays, depending on national legislations. Furthermore, an updated library with core literature of text books and relevant reference books, as well as access to relevant journals and relevant electronic literature have to be available.

2. Quality Management within Training institutions

It is expected that training institutions are engaged in structured quality assurance programmes. Training centres would be recognised within their own country as being suitable for being such and for being suitable for performing a wide range of diagnostic and therapeutic nuclear medicine procedures. It would be expected that training centres would be subject to regular review within their country and this would include data relating to the progress of trainees and their acquisition of specialist accreditation.

Appendix

Nuclear Medicine curriculum

The comprehensive curriculum including all the radiopharmaceuticals, diagnostic studies, therapies and indications is the ***UEMS-EANM European Nuclear Medicine Guide*** (edition 2020 https://www.nucmed-guide.app/#!/startscreen, new edition expected in 2024).

Competence levels

Competence level	*Competence required*
I	Theoretical knowledge (Minimum requirement for rarely performed procedures).
II	Good theoretical and practical knowledge but not up to a level such as the trainee is fully autonomous.
III	Both practical skills and very good theoretical knowledge, such as the trainee is fully autonomous.

1. Diagnostic procedures (alphabetic listing)

1.1. Cardiovascular system

Procedure	*Level III*	*Level II*	*Level I*
Myocardial perfusion SPECT	x		
Myocardial perfusion PET			x
Myocardial viability			x
Cardiac function (GBPS, MUGA & FPRNA)			x
Inflammation & Infection	x		
Amyloidosis	x		
Innervation		x	

1.2. Central nervous system

Procedure	*Level III*	*Level II*	*Level I*
[^{18}F]FDG PET and/or perfusion SPECT/CT	x		
Presynaptic dopaminergic imaging	x		
Brain tumours (incl. Amino Acids)	x		
Cisternography			x
Amyloid			x

1.3. Bone and joints

Procedure	*Level III*	*Level II*	*Level I*
Bone scintigraphy	x		
[^{18}F]NaF PET/CT			x

1.4. Respiratory system

Procedure	*Level III*	*Level II*	*Level I*
Lung perfusion	x		
Combined ventilation/perfusion	x		

1.5. Gastrointestinal, hepatobiliary systems and spleen

Procedure	*Level III*	*Level II*	*Level I*
Salivary gland		x	
Esophageal transit			x
Gastroesophageal reflux			x
Gastric emptying		x	
Gastrointestinal bleeding		x	
Meckel diverticulum		x	
Hepatobiliary system		x	
Bile acid malabsorption			x
Colon transit			x

1.6. Nephro-urinary system

Procedure	*Level III*	*Level II*	*Level I*
Assessment of renal function and transit	x		
Renal cortical imaging	x		
Direct or indirect radionuclide cystogram			x
Clearance methods			x

1.7. Endocrine system

Procedure	*Level III*	*Level II*	*Level I*
Thyroid scintigraphy	x		
Parathyroid imaging planar, SPECT/CT & PET	x		
Neck Ultrasound			x
Adrenal medulla & cortex		x	

1.8. Hematopoietic and lymphatic systems

Procedure	*Level III*	*Level II*	*Level I*
Splenic function		x	
Lymphoscintigraphy and intraoperative probe for sentinel lymph node localization	x		
Lymphoscintigrapy extremities	x		
Body fluid determination			x
Bone marrow imaging			x

1.9. Oncology

Procedure	*Level III*	*Level II*	*Level I*
[^{18}F]FDG	x		
Choline			x
PSMA radioligand	x		
Radiolabeled somatostatin receptors analogues	x		
FDOPA			x
MIBG		x	
Others *(see UEMS/EANM European NM Guide)*			x

1.10. Inflammation and infection (not bone scan)

Procedure	*Level III*	*Level II*	*Level I*
[^{18}F]FDG PET	x		
Labelled white blood cells & labelled anti-granulocyte monoclonal antibodies scintigraphy		x	

2. Therapeutic procedures

Procedure	*Level III*	*Level II*	*Level I*
Dosimetry		x	
Benign Thyroid Diseases	x		
Malignant Thyroid Diseases	x		
PSMA-Radioligand Therapy		x	
Neuroendocrine Tumors	x		
Malignant Neural Crest Tumors			x
Primary and Secondary Hepatic Malignancies			x
Palliation of Painful Bone Metastasis		x	
Others *(see UEMS/EANM European NM Guide)*			x

Table of Content