

HIGHER MEDICAL TRAINING

CURRICULUM

FOR

NUCLEAR MEDICINE

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INTRODUCTION

The trainee in Nuclear Medicine needs to gain a broad view of the needs of the community he or she serves. This requires not only the acquisition of certain knowledge and skills but also the development of appropriate attitudes enabling the trainee to look after the interests of patients, to work with other relevant health care professionals, to keep up with developments in the field and to bring these developments into the clinical arena. The most important function of the training programme in Nuclear Medicine is to educate individuals who will become consultants, capable of providing the highest standard of service to patients requiring Nuclear Medicine imaging or therapy. The aim of this educational process will be to develop positive attitudes towards lifelong learning and to equip the trainee to adapt to the changing expectations as well as to technological advances.

This document outlines the training objectives for all medical trainees at Specialist Registrar (SpR) grade (Generic curriculum) and also the specialty-specific objectives for Nuclear Medicine trainees (Nuclear Medicine curriculum). A more limited training encompassing only the imaging aspects of the curriculum will allow an individual to be trained as a Radionuclide Radiologist. In this document the training requirements for Nuclear Medicine physicians and Radionuclide Radiologists are considered separately although there are many shared training aims and objectives.

Higher Medical Training

Specialists in Nuclear Medicine have ultimate responsibility for Nuclear Medicine services and will hold the appropriate certificate from Health Ministers to administer radioactive substances. Applicants for Higher Medical Training (HMT) should have completed a minimum of two years General Professional Training (GPT) in approved posts and obtained the MRCP (UK) or (I), FRCR (or MRC Paed).

GPT is defined as follows:

- ◆ A minimum of 2 years in approved posts with direct involvement in patient care and offering a wide range of experience in a variety of specialties.
- ◆ 18 months of the 2 years must be spent in posts providing experience in the admission and early follow-up of acute emergencies.
- ◆ At least 6 of the 18 months must be spent on a service or services on which the emergency take is 'unselected'
- ◆ 'unselected take' is defined as acute medical intake encompassing the broad generality of medicine i.e. not restricted to any single or small group of specialties. If any major component of acute medicine (e.g. cerebrovascular accidents, myocardial infarctions) is excluded from the take, this experience must be obtained in other posts. During the period on 'unselected take' trainees should have an on-call commitment, which averages no less than 4 takes per month.

Graduates without the MRCP or FRCR who compete for HMT posts must provide evidence of appropriate knowledge, training and experience. Overseas graduates must also provide evidence of satisfactory completion of appropriately supervised general professional training.

General Description

Nuclear Medicine is the speciality that is responsible for the administration of unsealed radioactive substances to patients for diagnosis, therapy or research. Trainees will require appropriate instruction in the clinical, scientific and legal aspects of the speciality.

Training is provided in three main ways.

- 1) Apprenticeship, learning directly from medical specialists, scientists and others providing a nuclear medicine service.
- 2) Local education. This will include participation in relevant outpatient clinics, interdisciplinary meetings e.g. with x-ray departments, clinical meetings and also more formal education such as lectures and tutorials, courses on radiation protection etc. in the hospital of training.
- 3) External education. Trainees will normally be expected to take a taught MSc course in Nuclear Medicine although it is not obligatory. Trainees should by the end of their training have attended some or all of the following meetings British Nuclear Medicine Society (BNMS), United Kingdom Radiology Congress (UKRC), European Association of Nuclear Medicine (EANM), Society of Nuclear Medicine (SNM) and courses organised by relevant specialist societies such as British Institute of Radiology, BNMS, Royal College of Physicians (RCP) or Royal College of Radiologists (RCR).

Training programmes will include instruction in:

- 1) Scientific Principles. The scientific basis of the speciality requires all trainees to receive instruction on relevant basic science, instrumentation, radiation protection, radiopharmacy, and radiochemistry.
- 2) Clinical Nuclear Medicine. The trainee will need to be involved with assessing the clinical need for investigations and the choice of the most appropriate investigation, be able to supervise and ensure that it is performed to a high standard, and become experienced in interpreting results and issuing reports. He/she should be familiar with data manipulation and image processing. Training must include paediatric investigations. Experience must be gained in radionuclide therapy, including criteria for patient selection and supervision of follow-up after treatment.
- 3) Legal and Regulatory requirements. There are complex legal and regulatory requirements concerning nuclear medicine. These include the production and administration of radiopharmaceuticals, radiation protection relating to the patient, the general public and hospital staff, and requirements for research and patient consent. Trainees will need appropriate instruction in all of these aspects of nuclear medicine.
- 4) Practical Skills aimed at the development of skills in the safe administration of unsealed radioactive substances to patients, The practical supervision of patient scanning procedure, data manipulation and image processing

AIMS OF TRAINING IN NUCLEAR MEDICINE

The educational process in Nuclear Medicine aims to produce physicians who:

- have acquired and developed team working and leadership skills
- work effectively with other healthcare professionals
- are able to identify and take responsibility for their own educational needs and the attainment of these needs
- are effective educators of both patients and colleagues
- manage time and resources to the benefit of themselves, their patients and colleagues
- apply appropriate knowledge and skill in the diagnosis of patients referred to them
- are able to act as safe independent practitioners while recognising the limitation of their own expertise and the obligation to seek assistance of colleagues where appropriate
- are competent to perform the core investigations and therapy required in Nuclear Medicine.
- can use effectively current methods in information technology
- use skills of lifelong learning to keep up to date with developments in Nuclear medicine
- develop clinical practice based on analysis of relevant clinical trials and on understanding of research methodologies.

- are able to use the tools of audit and clinical governance to modify, improve and maintain standards in clinical practice.
- are able to work within the legal framework relating to the use of radioactive materials.

DURATION AND ORGANIZATION OF TRAINING

The duration of HMT in Nuclear Medicine is four years and it will be provided in approved centres. Those entering with FRCR may be exempt for up to two years of the training programme provided that the GPT requirements are met. However, such individuals will need to spend at least two years whole time equivalent (WTE) in the clinical training programme and research cannot be counted towards their CCST. The programme to which the trainee is appointed will have named consultant trainers. In addition, there will be a Programme Director with overall responsibility for the organisation of training.

FLEXIBLE TRAINING

Trainees who are unable to work full-time are entitled to opt for flexible training programmes. EC Directive 93/16/EEC requires that:

- 1) *Part-time training shall meet the same requirements as full-time training from which it will differ only in the possibility of limiting participation in medical activities to a period of at least half of that provided for full-time trainees;*
- 2) *The competent authorities shall ensure that the total duration and quality of part-time training of specialists are not less than those of full-time trainees.*

The above provisions must be adhered to. Flexible trainees should undertake a pro rata share of the out of hours duties (including on-call and other out of hours commitments) required of those full-time colleagues in the same programme and at the equivalent stage. For details of appointment and funding arrangements for flexible trainees, please see the revised 'Guide to Specialist Registrar Training' (February 1998).

RESEARCH

A period of supervised research of good quality is considered a highly desirable part of HMT in Nuclear Medicine. A relevant research period may contribute up to 12 months towards the total duration of HMT, the balance to be comprised of clinical training. Some trainees may wish to spend two or three years in research, either before entering HMT or by stepping aside from clinical training after entering a programme. This is perfectly acceptable but only one year will count towards the programme. For those undertaking an extended period of research *after entering a programme* and obtaining their NTN, a limited amount of additional educational credit may be granted at the discretion of the SAC for clinical work relevant to the programme undertaken in the course of research beyond the initial year. This concession does not apply to those undertaking research prior to entry to a higher training programme or to radiology trainees undergoing shortened training.

TRAINING RECORD

The trainee will maintain a Training Record. It will be counter-signed as appropriate by the Educational Supervisor(s) to confirm satisfactory fulfilment of the required training experience and the acquisition of the competencies that are enumerated in the Speciality Curriculum. It will remain the property of the trainee and must be produced at the annual assessments.

GENERIC CURRICULUM

Introduction

This section sets out the generic knowledge skills and attitudes (or, more readily assessed, behaviour) that are common to all of the medical specialties. All SpRs must be able to meet these objectives. No time scale is recommended for these competencies but they must all be attested for before completion of training. However failure to achieve satisfactory progress in meeting many of these objectives at an early stage would be cause for concern about the SpRs ability to be adequately trained.

1. GOOD CLINICAL CARE

1 A) HISTORY, EXAMINATION, INVESTIGATIONS, TREATMENT [THERAPEUTICS] & NOTEKEEPING SKILLS:

Objective: To be able to carry out specialist assessment of patients by means of clinical history taking and physical examination and use of relevant treatments and investigations.

Subject	Knowledge	Skills	Attitudes
(i) History	Define the patterns of symptoms found in patients presenting with disease.	Be able to take and analyse a clinical history in a relevant succinct and logical manner. Be able to overcome difficulties of language, physical and mental impairment. Use interpreters and advocates appropriately.	Show empathy with patients. Appreciate the importance of psychological factors of patients and relatives. Appreciate the interaction of social factors and the patient's illness.
(ii) Examination	Define the pathophysiological basis of physical signs. Define the clinical signs found in diseases.	Be able to perform a reliable and appropriate examination.	Respect patients' dignity and confidentiality. Acknowledge cultural issues. Appropriately involve relatives. Appreciate the need for a chaperone.

Subject (iii) Investigations including imaging	Knowledge Define the pathophysiological basis of investigations. Define the indications for investigations. Define the risks and benefits of investigations. Know the cost effectiveness of individual investigation.	Skills Ability to interpret the results of investigations. Ability to perform investigations competently where relevant. Ability to liaise and discuss investigations with colleagues and to order them appropriately.	Attitudes Understand the importance of working with other health care professionals and team working. Show a willingness to provide explanation to patient as to rationale for investigations, and possible unwanted effects.
(iv) Treatment (Therapeutics)	Explain the scientific theory relating to Pharmacology and the pathophysiology of pain.	Ability to accurately assess the patients needs. Ability to initiate the appropriate prescription of analgesia, blood products and medication. Ability to manage transfusion reactions and side-effects.	Show appropriate attitudes towards patients and their symptoms and be conscious of religious or other philosophical contexts particularly in the arena of blood products. Clearly and openly explain treatments and side effects of drugs.
(v) Note keeping, letters etc	Be able to write discharge summaries, discharge letters, outpatient letters, medico- legal reports. Use of email, internet and the telephone. Define the structure, function and legal implications of medical records & medico-legal reports. Know the relevance of the data protection pertaining to patient confidentiality.	Record concisely, accurately, confidentially and legibly the appropriate elements of the history, examination, results of investigations, differential diagnosis and management plan. Date and sign all records.	Appreciate the importance of timely dictation cost effective use of medical secretaries and the growing use of electronic communication. Be aware of the need for prompt and accurate communication with primary care and other agencies. Show courtesy towards medical secretaries and clerical staff.

1 B) MANAGING CHRONIC DISEASE

Objective: To be able to carry out specialist assessment and treatment of patients with chronic disease and to demonstrate effective management of chronic disease states

Subject	Knowledge	Skills	Attitudes
Management of chronic disease.	<p>Define the clinical presentation and natural history of patients with chronic disease.</p> <p>Define the role of rehabilitation services, pain control and palliative care.</p> <p>Define the concept of quality of life and how it can be measured.</p>	<p>Maintain hope whilst setting long term realistic goals.</p> <p>Develop long term management plans.</p> <p>Act as patient advocate in negotiations with support services.</p> <p>Have skills in palliative care including care of the dying.</p>	<p>Treating each patient as an individual.</p> <p>Appreciate the effects of chronic disease states on patients and their relatives.</p> <p>Develop and sustain supportive relationships with patients with chronic disease.</p> <p>Appreciate the impact of chronic disease on patients and their relatives.</p> <p>Appreciate the importance of co-operation with primary care.</p>

1 C) TIME MANAGEMENT AND DECISION MAKING:

Objective: To demonstrate that the trainee has the knowledge, skills and attitudes to manage time and problems effectively.

Subject	Knowledge	Skills	Attitudes
(i) Time management	<p>Know which patients/tasks take priority.</p>	<p>Start with the most important tasks.</p> <p>Work more efficiently as clinical skills develop.</p> <p>Recognise when he/she is falling behind and re-prioritise or call for help.</p>	<p>Have realistic expectations of tasks to be completed by self and others.</p> <p>Willingness to consult and work as part of a team.</p>
(ii) Decision making	<p>Understand clinical priorities for investigation and management.</p>	<p>Analyse and manage clinical problems.</p>	<p>Be flexible and willing to change in the light of changing conditions.</p> <p>Be willing to ask for help.</p>

2. COMMUNICATION SKILLS:

Objective: Demonstrate effective communication with patients, relatives and colleagues in the circumstances outlined below.

Circumstance	Knowledge	Skills	Attitudes
(i) Within a consultation	Know how to structure the interview to identify the patient's: concerns / problem list / priorities expectations understanding acceptance	Listen. Use open questions followed by appropriate closed questions. Avoid jargon and use familiar language Be able to communicate both verbally and in writing to patients whose first language may not be English in a manner that they understand. Use interpreters appropriately. Give clear information and feedback to patients and share information with relatives when appropriate Reassure 'worried well' patients.	Demonstrate an understanding of the need for involving patients in decisions offering choices respecting patients views dress and appearance should be appropriate to the clinical situation and patient sensibility
(ii) Breaking bad news	Know how to structure the interview and where it should take place. Be aware of the normal bereavement process and behaviour. Have awareness of organ donation procedures and role of local transplant co-ordinators.	Be able to break bad news in steps appropriate to the understanding of the individual and be able to support distress. Avoid jargon and use familiar language. Encourage questions. Maintain appropriate hope whilst avoiding inappropriate optimism.	Act with empathy, honesty and sensitivity.
(iii) Complaints	Have awareness of the local complaints procedures. Have awareness of systems of independent review.	Manage dissatisfied patients / relatives. Anticipate potential problems.	Act with honesty and sensitivity and promptly. Be prepared to accept responsibility.

<p>(iv) Communication with Colleagues</p>	<p>Know: how to write a problem orientated letter & discharge summary how to communicate with members of the MDT when to phone a GP or patient</p>	<p>Use appropriate language. Select an appropriate communication method.</p>	<p>Be prompt and respond courteously and fairly.</p>
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3. MAINTAINING GOOD MEDICAL PRACTICE:

LEARNING

Objective: To inculcate the habit of life long learning

Subject	Knowledge	Skills	Attitudes
Life long learning	Define continuing professional development.	Recognise and use learning opportunities. To use the potential of study leave to keep oneself up to date.	Be: self motivated, eager to learn, Show: willingness to learn from colleagues. willingness to accept criticism.

4. MAINTAINING TRUST

4 A) PROFESSIONAL BEHAVIOUR:

Objective: To ensure that the trainee has the knowledge, skills and attitudes to act in a professional manner at all times.

Subject	Knowledge	Skills	Attitudes
(i) Continuity of care	Understand the relevance of continuity of care.	Ensure satisfactory completion of reasonable tasks at the end of the shift/day with appropriate handover Documentation of/for handover. Make adequate arrangements to cover leave.	Recognise the importance of: punctuality, attention to detail.
(ii) Doctor-patient relationship	Understand all aspects of a professional relationship. Establish the limiting boundaries surrounding the consultation. Deal with challenging behaviour in patients which transgress those boundaries, e.g. aggression, violence,	Help the patient appreciate the importance of cooperation between patient and doctor. Develop the relationship that facilitates solutions to patient's problems. Deal appropriately with behaviour	Adopt a non-discriminatory attitude to all patients and recognise their needs as individuals. Seek to identify the health care belief of the patient. Acknowledge patient rights to accept or reject advice. Secure equity of access to health care

	racism and sexual harassment.	falling outside the boundary of the agreed doctor patient relationship. in patients, e.g. aggression, violence, sexual harassment.	resources for minority groups.
(iii) Recognises own limitations	Know the extent of one's own limitations and know when to ask for advice.		Be willing to consult. and to admit mistakes.
(iv) Stress	Know the effects of stress Have a knowledge of support facilities for doctors.	Develop appropriate coping mechanisms for stress and ability to seek help if appropriate.	Recognise the manifestations of stress on self & others.
(v) Relevance of outside bodies	Have an understanding of the relevance to professional life of: The Royal Colleges GMC Postgraduate Dean Defence unions BMA Specialist Societies	Recognise situations when appropriate to involve these bodies/individuals.	Be open to constructive criticism. Accept professional regulation.
(vi) Personal health	Know of occupational health services. Know of one's responsibilities to the public. Know not to treat oneself or one's family.	Recognise when personal health takes priority over work pressures and to be able to take the necessary time off.	Recognise personal health as an important issue.

4 B) ETHICS AND LEGAL ISSUES:

Objective: To ensure the trainee has the knowledge and skills to cope with ethical and legal issues which occur during the management of patients with general medical problems.

Subject	Knowledge	Skills	Attitudes
(i) Informed consent	Know the process for gaining informed consent Understand appropriateness of consent to post mortem. How to gain consent for a research project	Give appropriate information in a manner patients understand and be able to gain informed consent from patients Appropriate use of written material	Consider the patient's needs as an individual
(ii) Confidentiality	Be aware of relevant strategies to ensure confidentiality. Be aware of situations when confidentiality might be broken	Use and share all information appropriately Avoid discussing one patient in front of another Be prepared to seek patients wishes before disclosing information	Respect the right to confidentiality.
(iii) Legal issues, particularly those relating to: death certification role of the Coroner/ Procurator Fiscal mental illness advance directives and living wills DVLA	Know the legal responsibilities of completing death certificates. Know the types of deaths that should be referred to the Coroner/ Procurator Fiscal. Know the indications for section under the mental health act. Know the conditions that patients should report to the DVLA. Know responsibilities in serious criminal matters.	Completion of death certificates. Liaison with the Coroner/Procurator Fiscal. Check whether the patient has an advance directive or living will. Able to obtain suitable evidence or know whom to consult if in doubt.	Show attention to detail and recognise pressures of time. Respect living wills and advance directives. Act with compassion at all times.

4 C) PATIENT EDUCATION AND DISEASE PREVENTION:

Objective: To ensure that the trainee has the knowledge, skills and attitudes to be able to educate patients effectively.

Subject	Knowledge	Skills	Attitudes
(i) Educating patients about: disease investigations therapy	Know investigation procedures including possible alternatives / choices. Be aware of strategies to improve adherence to therapies.	Give information to patients clearly in a manner that they can understand including written information. Encourage questions. Negotiate individual treatment plans including action to be taken if patient deteriorates or improves.	Consider involving patients in developing mutually acceptable investigation plans. Encourage patients to access: further information patient support groups
(ii) Environmental & lifestyle risk factors	Understand the risk factors for disease including, diet, exercise, social deprivation, occupation, substance abuse, behaviour	Advise on lifestyle changes. Involve other health care workers as appropriate.	Suppress any display of personal judgement.
(iii) Smoking	Know: Effects of smoking on health Implications of addiction Smoking cessation strategies	To be able to advise on smoking cessation and supportive measures. Identify 'ready to quit' smokers.	Consider the importance of support during smoking cessation.
(iv) Alcohol	Understand the effects of alcohol on health and psychosocial wellbeing. Know of local support groups /agencies.	Advise on drinking cessation.	Suggest patient support groups as appropriate. Suppress any display of personal judgement.
(v) Illicit Drugs	Know the effects of common illicitly taken drugs. Legislation and Support Services. What to do if a patient takes a drugs overdose.	Be able to use detoxification services. Understand prevention policies and liaise with psychiatric services. Deal with other prevention and liaison services.	Provide sympathetic help. Suppress any display of personal judgement.
(vi) Epidemiology & screening	Know the methods of data collection and their limitations. Know diseases that are notifiable. Know principles of 1 ^o & 2 ^o prevention & screening.	Assess an individual patient's risk factors. Encourage participation in appropriate disease prevention or screening programmes.	Consider the: positive & negative aspects of prevention importance of patient confidentiality Respect patient choice.

5 WORKING WITH COLLEAGUES:

Objective: To demonstrate good working relationships with Colleagues

Subject	Knowledge	Skills	Attitudes
(i) Interactions between: hospital & GP hospital & other agencies e.g. social services medical and surgical specialties	Know the roles and responsibilities of team members. Know how a team works effectively. Know the roles of other clinical specialties and their limitations. Know the role of surgery and its limitations.	Delegate, show leadership and supervise safely Be able to communicate effectively. Handover safely. Seek advice if unsure. Recognise when input from another specialty is required for individual patients. Be able to work effectively with GPs, other medical and surgical specialists and other health care professionals	Show respect for others opinions. Be conscientious and work co-operatively. Respect colleagues, including non medical professionals, and recognise good advice. Recognise own limitations.

6 TEAM WORKING & LEADERSHIP SKILLS

Objective: To demonstrate the ability to work in clinical teams and to have the necessary leadership skills

Subject	Knowledge	Skills	Attitudes
Clinical teams. Respect others opinion Effective leadership skills	Roles & responsibilities of team members. How a team works. Ensuring colleagues understand the individual roles and responsibilities of each team member. Own professional status and specialty A knowledge of the field. The capacity to perceive the need for action and initiate that action	Respect skills and contribution of colleagues to be conscientious and work constructively. Respect for others opinion. To recognise your own limitations Objective setting; Lateral thinking; Planning; Motivating; Organising; Setting example; Negotiation skills.	Recognise own limitations. Enthusiasm; integrity; courage of convictions; imagination; determination; energy; and professional credibility.

7. TEACHING AND EDUCATIONAL SUPERVISION:

Objective: To demonstrate the knowledge, skills and attitudes to provide appropriate teaching, learning and assessment opportunities for

Subject	Knowledge	Skills	Attitudes
(i) To have the skills, attitudes and practices of a competent teacher	Identify adult learning principles. Identify learner needs. Structure of a teaching activity. Varied teaching strategies. Identify learning styles. Principles of evaluation.	Facilitate learning process. Identify learning outcomes. Construct educational objectives. Design and deliver an effective teaching event. Communicate effectively with the learners. Use effective questioning techniques. Teach large and small groups effectively. Select and use appropriate teaching resources. Give constructive effective feedback. Evaluate programmes and events Use different media for teaching that are appropriate to the teaching setting.	Demonstrate a willingness and enthusiasm to teach. Show respect for the learner. Demonstrate a professional attitude towards teaching. Show commitment to teach. Demonstrate a learner centred approach to teaching.
(ii) Assessment	Know the principles of assessment Know different assessment methods Define formative and summative assessment	Use appropriate assessment methods Give constructive, effective feedback	Be honest and objective when assessing performance.
(iii) Appraisal	Know the principles of appraisal Know the structure of the appraisal interview	Conduct effective appraisals	Show respect for the person being appraised.

8. RESEARCH [Where undertaken]

Trainees are encouraged to undertake a period of full time research and have a good knowledge of research methodology.

There should be active involvement with research projects throughout the training period.

Subject	Knowledge	Skills	Attitudes
To be able to plan and analyse a research project.	Know how to design a research study. Know how to use appropriate statistical methods. Know the principles of research ethics. Know how to write a scientific paper. Sources of research funding.	Undertake systematic critical review of scientific literature. Ability to frame questions to be answered by a research project. Develop protocols and methods for research. Be able to use databases. Be able to accurately analyse data. Be able to write a scientific paper. Have good written and verbal presentation skills.	Demonstrate curiosity and a critical spirit of enquiry. Ensure patient confidentiality. Demonstrate knowledge of the importance of ethical approval and patient consent for clinical research. Humility.

9. CLINICAL GOVERNANCE

Objective: Demonstrate an understanding of the context, the meaning and the implementation of Clinical Governance.

Subject	Knowledge	Skills	Attitudes
<p>(i) The organisational framework for Clinical Governance at local, health authority and national levels.</p> <p>Understanding of the benefits a patient might reasonably expect from Clinical Governance.</p> <p>Creating an environment where mistakes and mismanagement of patients can be openly discussed and learned from</p>	<p>Define the important aspects of Clinical Governance.</p> <p>Medical and clinical audit.</p> <p>Research and Development.</p> <p>Integrated care pathways.</p> <p>Evidenced based practice.</p> <p>Clinical effectiveness.</p> <p>Clinical risk systems.</p> <p>To define the procedures and the effective action when things go wrong in own practice or that of others.</p> <p>Complaints procedures.</p>	<p>Be an active partaker in clinical governance.</p> <p>Be able to undertake medical and clinical audit. Be actively involved in audit cycles.</p> <p>Be active in research and development.</p> <p>Critically appraise medical data research. Practice evidence based medicine.</p> <p>Aim for clinical effectiveness (best practice) at all times.</p> <p>Educate self, colleagues and other health care professionals.</p> <p>Be able to handle and deal with complaints in a focused and constructive manner. Learn from complaints.</p> <p>Develop and institute clinical guidelines and integrated care pathways. Be aware of advantages and disadvantages of guidelines.</p> <p>Report and investigate critical incidents.</p> <p>Take appropriate action if you suspect you or a colleague may not be fit to practice.</p>	<p>Make the care of your patient your first concern.</p> <p>Respect patients' privacy, dignity and confidentiality.</p> <p>Be prepared to learn from mistakes, errors and complaints.</p> <p>Recognise the importance of teamwork.</p> <p>Share best practice with others.</p>

(ii) Risk management	<p>Knowledge of such matters as H&S policy, policies on needle-stick injuries, note keeping, communications and staffing numbers.</p> <p>Knowledge of risk assessment, perception and relative risk</p> <p>Know the complications and side effects of treatments.</p>	<p>Confidently and authoritatively discuss risks with patients and to obtain informed consent.</p> <p>Able to balance risks and benefits with patients.</p>	<p>Willingness to respect and accept patients views and choices</p> <p>Willingness to be truthful and to admit error to patients, relatives and colleagues.</p>
(iii) Evidence	<p>Know & understand:</p> <ul style="list-style-type: none"> the principles of evidence based medicine the types of clinical trial the types of evidence 	<p>Able to critically appraise evidence.</p> <p>Ability to be competent in the use of databases, libraries and the internet.</p> <p>Able to discuss the relevance of evidence with individual patients</p>	<p>Display a keenness to use evidence in the support of patient care and own decisions therein.</p>
(iv) Audit	<p>Know & understand:</p> <ul style="list-style-type: none"> the audit cycle data sources data confidentiality 	<p>Involvement in on-going audit.</p> <p>Undertake at least one audit project</p>	<p>Consider the relevance of audit to:</p> <ul style="list-style-type: none"> benefit patient care clinical governance
(v) Guidelines	<p>Know the advantages and disadvantages of guidelines</p> <p>Methods of determining best practice</p>	<p>Ability to utilise guidelines</p> <p>Be involved in guideline generation, evaluation, review and updating.</p>	<p>Show regard for individual patient needs when using guidelines</p> <p>Willingness to use guidelines as appropriate</p>

10. STRUCTURE OF THE NHS AND THE PRINCIPLES OF MANAGEMENT

Objective: To display a knowledge of the structure and organization of the NHS Nationally and locally.

Trainees should attend a management course

Subject	Knowledge	Skills	Attitudes
<p>Structure of the NHS and the principles of management</p>	<p>Know the structure of the NHS, primary care groups, Trusts and Hospital Trusts.</p> <p>Know the local Trust structure including Chief Executives, Medical Directors, Clinical Directors and others. Know the role of postgraduate deaneries, specialist societies, the royal colleges and the general medical council.</p> <p>Know finance issues in general in the Health Service, especially budgetary management.</p> <p>Know the appointments procedures and the importance of equal opportunities.</p> <p>Know of Central Government health regulatory agencies (eg NICE, CHI, NCAA)</p>	<p>Develop skills in managing change and managing people.</p> <p>Develop interviewing techniques and those required for performance reviews.</p> <p>Be able to build a business plan.</p>	<p>Show an awareness of equity in health care access and delivery.</p> <p>Demonstrate an understanding of the importance of a health service for the population.</p> <p>Show respect for others, ensuring equal opportunities.</p>

11 INFORMATION USE AND MANAGEMENT

Objective: Demonstrate competence in the use and management of health information.

Subject	Knowledge	Skills	Attitudes
<p>To demonstrate good use of information technology for patient care and for own personal development.</p>	<p>Define how to retrieve and utilize data recorded in clinical systems. Define main local and national projects and initiatives in information technology and its applications. Define the stages of evaluation that new technology needs to go through. Demonstrate an understanding of the range of possible uses for clinical data and information and appreciate the dangers and benefits of aggregating clinical data. Define the main features, responsibilities and liabilities in the UK and Europe pertaining to confidentiality</p>	<p>Demonstrate competent use of database, word processing and statistics programmes. Define how to undertake searches and access web sites and health related databases. To critically appraise available software To apply the principles of confidentiality and their implementation in terms of clinical practice in the context of information technology.</p>	<p>Demonstrate the acquisition of new attitudes in patient consultations in order to make maximum use of information technology. Demonstrate appropriate techniques to be able to share information on computer with the patient in a constructive manner Adopt proactive and enquiring attitude to new technology.</p>

12. CROSS-SPECIALTY TOPICS

12 A) ADMISSIONS AND DISCHARGES

Objective: To provide the trainee with the knowledge and skills to be able to safely manage the general medical 'take'.

Subject	Knowledge	Skills	Attitudes
'Take' management	Medical indications for urgent investigation and therapy Skills and capabilities of members of the 'on-take' team When to seek help or refer to other specialties Knowledge of support available in the community	Ability to prioritise Interact effectively with other health care professionals Keep patients and relatives informed Receive referrals appropriately Cope with stress Delegate effectively and safely Keep an accurate patient list Handover safely with appropriate documentation	Sympathetic handling of acutely ill patients. Aware of the pressures on other members of staff.

12 B) Discharge Planning

Objective: To provide the trainee with the knowledge and skills to be able to plan difficult discharges for patients, particularly the elderly.

Subject	Knowledge	Skills	Attitudes
Discharge planning	Impact of physical problems on activities of daily living. Roles and skills of members of the multidisciplinary team including nurses, OTs, physio's, speech therapists and psychologists discharge co-ordinators and social workers. Impact of unnecessary hospitalisation Available support in primary care .	Recognise when in-patient care is not required Effective contribution to discharge planning meetings. Liaison and communication with patient, family and primary care. Write reports for appropriate bodies.	Display empathy. Show an awareness of family dynamics and socio-economic factors influencing success of discharge

12 C) RESUSCITATION

Objective: To provide the trainee with the knowledge and skills to be able to recognise critically ill patients, take part in advanced life support, feel confident to lead a resuscitation team under supervision and use the local protocol for deciding when not to resuscitate patients.

Subject	Knowledge	Skills	Attitudes
(i) Recognise when a patient is critically ill.	Know how life-threatening emergencies present and how to treat them.	Perform initial assessment Manage life threatening emergencies Recognise when to call for help from seniors or other specialties e.g. ITU	Keep calm Recognise priorities. Recognise the dignity of patients. Keep relatives informed.
(ii) Advanced life support	Advanced life support algorithms. Role and side effects of commonly used anti-arrhythmics and cardiac support drugs.	Recognise cardiac arrhythmias. Perform emergency defibrillation. Perform emergency endo-tracheal intubation.	Display a calm and confident demeanour
(iii) Lead a cardiac arrest team	Role and responsibilities of the team leader.	Safe and effective communication and delegation	Be calm and realistic
(iv) Do not resuscitate orders (DNR)	Know local and national protocols for DNR orders. Know legal and ethical considerations.	Support patients and families.	Ability to empathise with relatives and to explain the consequences of DNR orders with compassion and without giving undue hope Act with empathy and sensitivity. Respect living wills and advance directives.

12 D) NUTRITION

Objective: To provide the trainee with the knowledge and skills in the nutritional issues listed below.

Subject	Knowledge	Skills	Attitudes
(i) Nutritional status	Impact of: disease on nutritional status malnutrition on clinical outcomes	Assessment of nutritional status	Recognise cultural and religious issues
(ii) Nutrition support	Principles and routes of nutrition support Role of nutrition support team (NST) Indications and arrangement of PEG tubes	Naso-gastric intubation Central venous access	Identify those needing nutrition support or advice and the significance of the doctor in providing such advice. Recognise: the skills of others e.g. specialist nurses, pharmacist, dieticians when to consult NST

NUCLEAR MEDICINE CURRICULUM

Introduction

This section details the specialty-specific objectives for higher medical training in Nuclear Medicine. The objectives are outlined in terms of the knowledge and skills required for comprehensive training in Nuclear Medicine. The attitudes or behaviour expected of trainees is the same as those outlined in the generic curriculum above. The curriculum also sets out how the competencies will be achieved and assessed. All SpRs must be able to meet these objectives that are regarded as core. It is however recognised that some Nuclear Medicine investigations are performed infrequently making it difficult for the trainee to achieve competence during the period of training. The curriculum takes account of this by making the acquisition of certain skills **optional** (those marked with an asterisk in the curriculum). Nevertheless, the knowledge surrounding these skills remains core even where practical experience is optional.

Furthermore, it is recognised that many training institutions can no longer provide comprehensive training on site and a trainee must be prepared to go to other approved institutions that will compliment the training offered by the base institution. As with the generic curriculum it is recognised that individual trainees will progress at different rates depending on the training programme. However failure to achieve satisfactory progress in meeting many of these objectives at an early stage would be cause for concern about the SpRs ability to be adequately trained.

Common Objectives:

Certain goals have been identified as common to all of the stated objectives that form the curriculum of Nuclear Medicine Training. In the following pages the term 'evaluate' in the 'Objectives' column is taken to incorporate all of the following abilities:

1. To define the indications for radionuclide imaging of the particular test.
2. To understand the role of comparative tests for the stated indication.
3. To prepare the patient for the test.
4. To assess the radiation protection issues involved and discuss these with the patient and carers.
5. To perform the investigation and analysis.
6. To provide quality assurance for the scan procedure.
7. To assess and interpret the resultant images.
8. To provide a written report of the test.
9. To liaise with the referring clinician.
10. To audit the results of the test.

Table 1 Teaching and learning methods

Competence may be attained by the following methods

Key	Teaching and Learning Method
1	Basic Science Courses
2	Personal Study
3	Local Tutorials
4	Vetting Request Forms
5	Task-specific on-the-job training
6	Tutored-reporting of scans
7	Tailored clinical experience
8	Multidisciplinary meetings
9	Post-graduate education courses
10	Research projects
11	Audit projects
12	Planning and delivery of teaching
13	Distance/interactive learning

CORE CURRICULUM: BASIC SCIENCE

Objective: to provide the trainee with a working knowledge of the basic science appropriate to Nuclear Medicine

Subject	Knowledge	Skills	Attitudes
I Physics and mathematics	A. Structure and modes of decay of radioactive atoms B. Interaction of emissions from radioactive atoms with matter C. Biological implications of and radiation hazards from ionising radiation. D. Molecular biology E. Probability theory F. Parametric and non-parametric statistics G. Appropriate mathematics and physics applied to radionuclide tracer theory, modelling of tracer kinetics and quantitative imaging.		

Teaching and Learning Methods 1, 2, 3, 9, 13 (see Table 1).

CORE CURRICULUM: BASIC SCIENCE

Objective: to provide the trainee with a working knowledge of the basic science appropriate to Nuclear Medicine

Subject	Knowledge	Skills	Attitudes
II Instrumentation and computers.	A. Theory of systems used to detect and analyse emissions from radioactive atoms B. Knowledge of how detection systems are used, calibrated and tested in Nuclear Medicine C. Principles of collimation and practical experience with the use of collimators D. Principles of single-photon emission tomography and coincidence counting E. Principles of image reconstruction.	A. Practical experience with the use of monitoring devices, probes, well counters, dose calibrators, gamma cameras, and positron emission tomography systems B. Use of computers to display and process images	A. Willing to learn new skills and keep up to date with developments in technology

Teaching and Learning Methods 1, 2, 3, 5, 9, 10, 13 (see Table 1).

CORE CURRICULUM: BASIC SCIENCE

Objective: to provide the trainee with a working knowledge of the basic science appropriate to Nuclear Medicine

Subject	Knowledge	Skills	Attitudes
III Radiation biology and radiation protection.	A. Theory of biological effects of high and low-level radiation from unsealed sources B. Calculation of radiation dose from radiopharmaceuticals (Effective dose [ED]) C. Basic principles of radionuclide therapy D. Nature of the cancerous process and the radiobiological basis of cancer radionuclide therapy E. Management of radiation accidents relating to Nuclear Medicine.	A. The safe handling of radiopharmaceuticals B. Deploy appropriate signs in Nuclear Medicine Departments. C. Write local rules for the use of unsealed source radiation D. Demonstrate ability to handle incidents of radioactive spillage or contamination	A. Appreciate the importance of safe handling of radiopharmaceuticals for self and for others

Teaching and Learning Methods 1, 2, 3, 5 (see Table 1).

CORE CURRICULUM: BASIC SCIENCE

Objective: to provide the trainee with a working knowledge of the basic science appropriate to Nuclear Medicine

Subject	Knowledge	Skills *	Attitudes
IV Radiochemistry and radiopharmacy.	A. Production of radionuclides using reactors, cyclotrons and generators B. Physical properties of radionuclides, clinical applications. C. Physicochemical and biological properties of different radiopharmaceuticals in routine clinical practice, clinical trials and under development D. Different formulations used in Nuclear Medicine E. Cell Labelling techniques F. Principles of Quality Assurance (QA) in the radiopharmacy G. Quality control parameters which determine the quality of radiopharmaceuticals including radionuclide & radiochemical purity H. Principles of aseptic preparation	A. Perform elution of a technetium generator B. Prepare a cold kit C. Perform cell labelling D. Perform simple tests of radionuclide and radiochemical purity E. Demonstrate techniques of aseptic preparation	A. Show attention to detail in handling radiopharmaceuticals and in ensuring radiochemical and radionuclide purity and also aseptic technique.

Teaching and Learning Methods 1, 2, 3, 5, 8, 9, 10, 11, 13 (see Table 1).

CORE CURRICULUM: BASIC SCIENCE

Objective: to provide the trainee with a working knowledge of the basic science appropriate to Nuclear Medicine

Subject	Knowledge	Skills	Attitudes
V Tracer principles and techniques and in vitro studies.	A. Kinetics of radioactive tracers used in Nuclear Medicine B. Use of principles of kinetics and modelling techniques to calculate parameters such as glomerular filtration rate etc. C. Physiological principles of tracer techniques D. Errors associated with the quantitative measurements E. Principles of RIA (Radioimmunoassay) F. Principles of ELISA (Enzyme-linked immunoadsorbant assay)	See individual non-imaging diagnostics	See individual non-imaging diagnostics

Teaching and Learning Methods 1, 2, 3, 5, 6, 9, 13 (see Table 1).

CORE CURRICULUM: BASIC SCIENCE

Objective: to provide the trainee with a working knowledge of the basic science appropriate to Nuclear Medicine

Subject	Knowledge	Skills	Attitudes
VI The regulatory framework of Nuclear Medicine.	<p>A. National and international regulatory requirement on the practice of nuclear medicine including: IRR99; MARS legislation; ARSAC; RSA 93; IR(ME)R 2000; Medical guidance notes; Product licenses and other appropriate legislation.</p> <p>B. Regulatory requirements which apply to the design and operation of radiopharmacies GMP 1997 (Orange Guide)</p> <p>C. Regulations controlling transport of radioactive materials in the UK RM(Road Transport) (GB) R 1996</p> <p>D. Mechanism by which the regulations are applied and policed within the UK</p> <p>E. Health and safety regulations governing safe practice e.g. COSHH Regulations 1999</p> <p>F. ALARA (as low as reasonably achievable) and ALARP (as low as reasonably practical)</p> <p>G. Any subsequent revisions of or additions to the above legislation.</p>	<p>A. Demonstrate ability to translate the regulations into local practice</p>	<p>A. Show willingness to keep up with developments in the regulations governing nuclear medicine</p> <p>B. Appreciates the need to work with others in ensuring that the regulations are strictly adhered to.</p>

Teaching and Learning Methods 1, 2, 3, 8, 9, 13 (see Table 1).

CORE IMAGING: CARDIOVASCULAR SYSTEM

Objective. To provide the trainee with the knowledge, skills and attitudes to evaluate coronary artery disease using radionuclide techniques.

Subject	Knowledge	Skills	Attitudes
I Myocardial perfusion and infarct imaging (see also PET imaging)	<p>A. Cardiac & coronary anatomy, cardiac physiology and pathophysiology.</p> <p>B. Principles of myocardial perfusion and SPECT imaging including ECG-gated SPECT.</p> <p>C. Radiopharmaceuticals currently used for myocardial perfusion imaging (e.g. ²⁰¹Tl and the ^{99m}Tc-labelled tracers) and infarction imaging (e.g. ^{99m}Tc-pyrophosphate and antimyosin antibodies) and those in development.</p> <p>D. Principles of physiological and pharmacological stress tests</p> <p>E. Imaging protocols used to evaluate myocardial viability, ischaemia and function.</p> <p>F. Indications for myocardial perfusion and infarction imaging</p> <p>G. Role of comparative assessment methods including the exercise ECG, stress echocardiography and coronary angiography.</p> <p>H. Radiation protection issues</p>	<p>A. Preparation of the patient prior to the test.</p> <p>B. Measurement and drawing up of tracer.</p> <p>C. Performance of cardiac stress test using physiological or pharmacological techniques</p> <p>D. Injection of the tracer.</p> <p>E. Setting up of instrumentation for ECG-gating and SPECT acquisition.</p> <p>F. Performance of the scans developing good technique allied to a knowledge of the pitfalls</p> <p>G. Techniques of tomographic reconstruction, qualitative and quantitative analysis, and display, including knowledge of image artefacts.</p> <p>H. Image interpretation and reporting including sufficient number of patient studies to assess utility, sources of error, normal variants and artefacts.</p> <p>I. Audit outcome of scan results.</p>	<p>A. Recognise the importance of proper vetting of request forms and for patient evaluation prior to the test.</p> <p>B. Show willingness to provide explanation to patient as to nature of the investigation and to put them at ease.</p> <p>C. Appreciate the importance of timely reporting and of prompt and accurate communication of the result to the referring clinician.</p> <p>D. Consider the importance of audit in the outcome of results</p> <p>E. Show openness to critical feedback of reports</p> <p>F. Appreciate the importance of keeping up-to-date with developments and with relevant medical literature.</p> <p>G. Show awareness of health and safety issues</p>

Teaching and Learning Methods 1-13 (See Table 1)

CORE CURRICULUM. CARDIOVASCULAR SYSTEM

Objective To provide the trainee with the knowledge, skills and attitudes to evaluate ventricular function using radionuclide techniques

Subject	Knowledge	Skills	Attitudes
<p>II Radionuclide ventriculography</p>	<p>A. Cardiac physiology and pathophysiology. B. Principles of radionuclide ventriculography (first pass and equilibrium techniques, rest and exercise studies) C. Radiopharmaceuticals used for assessment of radionuclide ventriculography (^{99m}Tc-labelled red cells) D. Indications for radionuclide ventriculography. E. Role of comparative techniques such as echocardiography and contrast ventriculography. F. Radiation protection issues</p>	<p>A. Preparation of the patient prior to the test. B. Measurement and drawing up of tracer. C. Injection of the tracer. D. Setting up of instrumentation for gated acquisition. E. Performance of rest and stress scans developing good technique allied to a knowledge of the pitfalls F. Data processing and quantification. G. Image interpretation and reporting of sufficient number of patient studies to assess utility, sources of error, normal variants and artefacts. H. Audit outcome of results</p>	<p>A. Recognise the need for proper vetting of request forms and for patient evaluation prior to the test. B. Show willingness to provide explanation to patient as to nature of the investigation and to put them at ease. C. Appreciate the importance of timely reporting and of prompt and accurate communication of the result to the referring clinician. D. Consider the importance of audit in the outcome of results E. Show openness to critical feedback of reports F. Appreciate the importance of keeping up-to-date with developments and with relevant medical literature. G. Show awareness of health and safety issues</p>

Teaching and Learning Methods 1-13 (See Table 1)

CORE CURRICULUM: CENTRAL NERVOUS SYSTEM

Objective: To provide the trainee with the knowledge, skills and attitudes to evaluate the central nervous system (cns) using radionuclide techniques.

Subject	Knowledge	Skills	Attitudes
Central nervous system imaging	<ul style="list-style-type: none"> A. Basic neuroanatomy, neurophysiology and neurochemistry. B. Radiopharmaceuticals currently in use for cns imaging and those in development. C. Indications for cerebral blood flow (rCBF) imaging using tracers such as HMPAO. D. Indications for blood-brain barrier imaging. E. Indications for neuroreceptor imaging. F. Role of comparative imaging tests such as ultrasound, CT and MR scanning G. Radiation protection issues 	<ul style="list-style-type: none"> A. Preparation of the patient prior to the test. B. Choice of radiopharmaceutical and imaging protocol. C. Radiotracer preparation and its quality assurance. D. Radiopharmaceutical injection E. Setting up of instrumentation for SPECT acquisition and performance of scan. F. Data processing, image reconstruction and quantification G. Image interpretation and reporting of sufficient number of patient studies to assess utility, sources of error, normal variants and artefacts. H. Audit outcome of studies 	<ul style="list-style-type: none"> A. Recognise the importance of proper vetting of request forms and of patient evaluation prior to the test. B. Show willingness to provide explanation to patient as to nature of the investigation and to put them at ease. C. Appreciate the importance of timely reporting and of prompt and accurate communication of the result to the referring clinician. D. Consider the importance of audit in the outcome of results E. Show openness to critical feedback of reports F. Appreciate the importance of keeping up-to-date with developments and with relevant medical literature. G. Show awareness of health and safety issues

Teaching and Learning Methods 1-13 (See Table 1)

CORE IMAGING: ENDOCRINE SYSTEM

Objective To provide the trainee with the knowledge, skills and attitudes to evaluate endocrine disorders using radionuclide techniques.

Subject	Knowledge	Skills	Attitudes
Adrenal Imaging	<ul style="list-style-type: none"> A. Basic science including the biochemistry of adrenal disorders. B. Clinical syndromes associated with adrenal disease. C. Basic science of adrenal imaging with ¹²³I MIBG and cholesterol imaging agents. D. Indications for radionuclide adrenal imaging. E. Sensitivity and specificity of the tests. F. Role of comparative tests in the diagnosis of adrenal disorders. G. Radiation protection associated with ¹²³I MIBG and cholesterol imaging agents 	<ul style="list-style-type: none"> A. Preparation of the patient prior to the test. B. Measurement and drawing up of the tracer. C. Injection of the radiopharmaceuticals. D. Performance of the scans developing good technique allied to a knowledge of the pitfalls associated with the study E. Use of renal subtraction scanning F. Image processing and display. G. Image interpretation including the reporting of sufficient number of patient studies to assess utility, sources of error, normal variants and artefacts. H. Audit of the outcome of the tests 	<ul style="list-style-type: none"> A. Recognise the importance of proper vetting of request forms and of patient evaluation prior to the test. B. Show willingness to provide explanation to patient as to nature of the investigation and to put them at ease. C. Appreciate the importance of timely reporting and of prompt and accurate communication of the result to the referring clinician. D. Consider the importance of audit in the outcome of results E. Show openness to critical feedback of reports F. Appreciate the importance of keeping up-to-date with developments and with relevant medical literature. G. Show awareness of health and safety issues

Teaching and Learning Methods 1, 2, 3, 4, 5, 6, 8-13 (See Table 1)

CORE IMAGING: ENDOCRINE SYSTEM

Objective. To provide the trainee with the knowledge, skills and attitudes to evaluate thyroid disorders using radionuclide techniques*

Subject	Knowledge	Skills	Attitudes
Thyroid Scans and Uptake Measurements	<p>A. Developmental anatomy physiology and biochemistry of the thyroid gland.</p> <p>B. Clinical presentation and management of thyroid disorders.</p> <p>C. Science of thyroid imaging and uptake using $^{99m}\text{TcO}_4$ and ^{123}I tracers and the perchlorate discharge test.</p> <p>D. Indications for radionuclide thyroid imaging</p> <p>E. Role of complementary and comparative investigations including thyroid biochemistry, immunology, ultrasound and CT scans and FNA in the evaluation of thyroid disorders.</p> <p>F. Radiation protection associated with the radiopharmaceuticals.</p>	<p>A. Preparation of the patient for the test.</p> <p>B. Clinical evaluation of the thyroid gland.</p> <p>C. Measurement and drawing up of the radiopharmaceuticals.</p> <p>D. Injection of the tracer</p> <p>E. Choice of collimator</p> <p>F. Performance of the scans developing good technique allied to knowledge of the pitfalls associated with the study.</p> <p>G. Data and image processing, quantification and image display.</p> <p>H. Image interpretation and reporting of sufficient number of patient studies to assess the utility, pitfalls, normal variants and artefacts.</p> <p>I. Correlating the scan and clinical findings</p> <p>J. Audit of outcome.</p>	<p>A. Recognise the importance of proper vetting of request forms and of patient evaluation prior to the test.</p> <p>B. Show willingness to provide explanation to patient as to nature of the investigation and to put them at ease.</p> <p>C. Appreciate the importance of timely reporting and of prompt and accurate communication of the result to the referring clinician.</p> <p>D. Consider the importance of audit in the outcome of results</p> <p>E. Show openness to critical feedback of reports</p> <p>F. Appreciate the importance of keeping up-to-date with developments and with relevant medical literature.</p> <p>G. Show awareness of health and safety issues</p>

*** Includes attendance at Thyroid clinics.**

Teaching and Learning Methods 1-13 (See Table 1)

CORE IMAGING: ENDOCRINE SYSTEM

Objective To provide the trainee with the knowledge, skills and attitudes to evaluate parathyroid disorders using radionuclide techniques.

Subject	Knowledge	Skills	Attitudes
Parathyroid Imaging	<p>A. Developmental anatomy and physiology of the parathyroid glands</p> <p>B. Clinical presentation of hyperparathyroidism.</p> <p>C. Basic science of parathyroid imaging using $^{201}\text{Tl}/^{99\text{m}}\text{Tc}$ and $^{99\text{m}}\text{Tc}/^{123}\text{I}$ subtraction and $^{99\text{m}}\text{TcMIBI}$ imaging as well as those tracers/protocols in development.</p> <p>D. Indications for radionuclide parathyroid imaging.</p> <p>E. Role of comparative tests in the evaluation of parathyroid disorders including ultrasound, selective venous catheterisation etc.</p> <p>F. Utility of intra-operative probe detection.</p> <p>G. Radiation protection associated with the scans.</p>	<p>A. Preparation of the patient prior to the test(s).</p> <p>B. Choice of imaging protocol.</p> <p>C. Measurement and drawing up of the radiopharmaceuticals.</p> <p>D. Administration of the radiopharmaceuticals.</p> <p>E. Performing the scans developing good technique allied to knowledge of the pitfalls associated with the study.</p> <p>F. Image processing and display.</p> <p>G. Image interpretation and reporting of sufficient number of patient studies to assess utility, pitfalls, normal variants and artefacts.</p> <p>H. Audit of outcomes.</p>	<p>A. Recognise the importance of proper vetting of request forms and of patient evaluation prior to the test.</p> <p>B. Show willingness to provide explanation to patient as to nature of the investigation and to put them at ease.</p> <p>C. Appreciate the importance of timely reporting and of prompt and accurate communication of the result to the referring clinician.</p> <p>D. Consider the importance of audit in the outcome of results</p> <p>E. Show openness to critical feedback of reports</p> <p>F. Appreciate the importance of keeping up-to-date with developments and with relevant medical literature.</p> <p>G. Show awareness of health and safety issues</p>

Teaching and Learning Methods 1-6, 8-13 (See Table 1)

CORE IMAGING: GASTROINTESTINAL SYSTEM

Objective. To provide the trainee with the knowledge, skills and attitudes to evaluate gastrointestinal disorders using radionuclide techniques.

Subject	Knowledge and skills	Skills*	Attitudes
I Salivary Gland Imaging	<ul style="list-style-type: none"> A. Physiology and pathophysiology of salivary gland disorders. B. Basic science of salivary gland function using $^{99m}\text{TcO}_4$. C. Indications for radionuclide salivary gland studies. D. Comparative investigations E. Radiation protection issues. 	<ul style="list-style-type: none"> A. Preparation of the patient prior to the test. B. Measurement and drawing up of the radiopharmaceutical. C. Radiopharmaceutical and salivary gland excretory stimulation administration. D. Performing the scans developing good technique and a knowledge of the pitfalls associated with the study. E. Data processing, image display and quantification. F. Image interpretation and reporting of sufficient number of patient studies to assess utility, pitfalls, normal variants and artefacts. G. Audit of outcome 	<ul style="list-style-type: none"> A. Recognise the importance of proper vetting of request forms and of patient evaluation prior to the test. B. Show willingness to provide explanation to patient as to nature of the investigation and to put them at ease. C. Appreciate the importance of timely reporting and of prompt and accurate communication of the result to the referring clinician. D. Consider the importance of audit in the outcome of results E. Show openness to critical feedback of reports F. Appreciate the importance of keeping up-to-date with developments and with relevant medical literature. G. Show awareness of health and safety issues

* Optional

Teaching and Learning Methods 1-6, 8-13 (See Table 1)

CORE IMAGING: GASTROINTESTINAL SYSTEM

Objective. To provide the trainee with the knowledge, skills and attitudes to evaluate gastrointestinal disorders using radionuclide techniques.

Subject	Knowledge	Skills*	Attitudes
<p>II Oesophageal transit and gastro-oesophageal reflux.</p>	<p>A. Physiology and pathophysiology of oesophageal transit and the lower oesophageal sphincter.</p> <p>B. Basic science of oesophageal motility and gastro-oesophageal reflux using tracers e.g. ^{99m}Tc colloid or DTPA.</p> <p>C. Indications for radionuclide oesophageal transit and reflux measurements.</p> <p>D. Comparative investigations including oesophageal imaging and manometry.</p> <p>E. Radiation protection issues.</p>	<p>A. Preparation of the patient prior to the test</p> <p>B. Measurement and drawing up of the radiopharmaceutical.</p> <p>C. Radiopharmaceutical administration including patient instruction and positioning.</p> <p>D. Performing the scans using appropriate acquisition techniques and knowledge of the pitfalls associated with the study.</p> <p>E. Image processing including quantification and display.</p> <p>F. Image and data interpretation and reporting of sufficient number of patient studies to assess utility, pitfalls, normal variants and artefacts.</p> <p>G. Audit of outcome.</p>	<p>A. Recognise the importance of proper vetting of request forms and of patient evaluation prior to the test.</p> <p>B. Show willingness to provide explanation to patient as to nature of the investigation and to put them at ease.</p> <p>C. Appreciate the importance of timely reporting and of prompt and accurate communication of the result to the referring clinician.</p> <p>D. Consider the importance of audit in the outcome of results</p> <p>E. Show openness to critical feedback of reports</p> <p>F. Appreciate the importance of keeping up-to-date with developments and with relevant medical literature.</p> <p>G. Show awareness of health and safety issues</p>

* Optional

Teaching and Learning Methods 1-13 (See Table 1)

CORE IMAGING: GASTROINTESTINAL SYSTEM

Objectives. To provide the trainee with the knowledge, skills and attitudes to evaluate gastrointestinal disorders using radionuclide techniques.

Subject	Knowledge	Skills	Attitudes
<p>III Gastrointestinal Transit Measurements</p>	<p>A. Physiology and pathophysiology of gastric emptying and small bowel and colonic transit. B. Clinical conditions known to lead to gastroparesis and to slow transit constipation C. Radiopharmaceuticals used to assess solid and liquid phase gastric emptying and to define the limits of the stomach. D. Radiopharmaceuticals used to assess small and large bowel transit including the use of large bowel stimulants. E. Indications for the above studies. F. Comparative tests of gastric emptying, small bowel and colonic transit assessment. G. Radiation protection issues.</p>	<p>A. Preparation of the patient prior to the test(s). B. Preparation and administration of radiopharmaceuticals. C. Performing the scans using appropriate acquisition techniques and a knowledge of the pitfalls. D. Data processing with ROI positioning and calculation of T_{1/2} emptying. E. Recognition of patterns of emptying (e.g. gastric dumping). F. Image interpretation and reporting of sufficient number of patient studies to assess utility, sources of error, normal variants and artefacts. G. Audit of outcome.</p>	<p>A. Recognise the importance of proper vetting of request forms and of patient evaluation prior to the test. B. Show willingness to provide explanation to patient as to nature of the investigation and to put them at ease. C. Appreciate the importance of timely reporting and of prompt and accurate communication of the result to the referring clinician. D. Consider the importance of audit in the outcome of results E. Show openness to critical feedback of reports F. Appreciate the importance of keeping up-to-date with developments and with relevant medical literature. G. Show awareness of health and safety issues</p>

Teaching and Learning Methods 1-6, 8-13 (See Table 1)

CORE IMAGING: GASTROINTESTINAL SYSTEM

Objective. To provide the trainee with the knowledge, skills and attitudes to evaluate gastrointestinal disorders using radionuclide techniques.

Subject	Knowledge	Skills	Attitudes
<p>IV Gastrointestinal blood loss and Meckel's diverticulum imaging</p>	<p>A. Anatomy and pathophysiology of gastrointestinal (GI) blood loss and Meckels diverticulum.</p> <p>B. Basic science of measuring GI bleeding using radionuclides including ^{99m}Tc colloid or labelled autologous red cells (in vivo or in vitro)</p> <p>C. Principles of detection of Meckel's diverticulum using ^{99m}TcO₄.</p> <p>D. Indications for GI blood loss studies and Meckel's test.</p> <p>E. Comparative tests for sources of GI blood loss and diagnosis of Meckels diverticulum.</p> <p>F. Radiation protection issues.</p>	<p>A. Preparation of the patient prior to the test.</p> <p>B. Measurement and drawing up of the radiopharmaceutical.</p> <p>C. Preparation and administration of radiopharmaceutical.</p> <p>D. Performing the scans developing good technique and a knowledge of the pitfalls associated with the study.</p> <p>E. Data processing and image display.</p> <p>F. Image interpretation and reporting of sufficient number of patient studies to assess utility, sources of error, normal variants and artefacts.</p> <p>G. Audit of outcome</p>	<p>A. Recognise the importance of proper vetting of request forms and of patient evaluation prior to the test.</p> <p>B. Show willingness to provide explanation to patient as to nature of the investigation and to put them at ease.</p> <p>C. Appreciate the importance of timely reporting and of prompt and accurate communication of the result to the referring clinician.</p> <p>D. Consider the importance of audit in the outcome of results</p> <p>E. Show openness to critical feedback of reports</p> <p>F. Appreciate the importance of keeping up-to-date with developments and with relevant medical literature.</p> <p>G. Show awareness of health and safety issues</p>

Teaching and Learning Methods 1-13 (See Table 1)

CORE IMAGING: GASTROINTESTINAL SYSTEM

Objective. To provide the trainee with the knowledge, skills and attitudes to evaluate gastrointestinal disorders using radionuclide techniques.

Subject	Knowledge	Skills*	Attitudes
V Hepatic and Splenic function assessment.	<p>A. Anatomy and physiology of the liver blood flow, Kupffer cell and the spleen.</p> <p>B. Radiopharmaceuticals used to evaluate hepatic reticuloendothelial (RES) function and suspected liver haemangioma.</p> <p>C. Hepatic blood flow measurements, first pass techniques, calculation of hepatic perfusion index (HPI) and choice of tracer (^{99m}Tc colloid or ^{99m}TcO₄)</p> <p>D. Assessment of hypersplenism using colloid or denatured red cells.</p> <p>E. Comparative tests of hepatic blood flow, RES and splenic function.</p> <p>F. Radiation protection issues</p>	<p>A. Preparation of the patient prior to the test.</p> <p>B. Choice of appropriate radiopharmaceutical and imaging protocol.</p> <p>C. Administration of the radiopharmaceutical.</p> <p>D. Performing the scans ensuring good technique and developing knowledge of the pitfalls.</p> <p>E. Data processing, calculation of the HPI and image display.</p> <p>F. Data and image interpretation and reporting of sufficient number of patient studies to assess utility, pitfalls, normal variants and artefacts.</p> <p>G. Audit of outcome</p>	<p>A. Recognise the importance of proper vetting of request forms and of patient evaluation prior to the test.</p> <p>B. Show willingness to provide explanation to patient as to nature of the investigation and to put them at ease.</p> <p>C. Appreciate the importance of timely reporting and of prompt and accurate communication of the result to the referring clinician.</p> <p>D. Consider the importance of audit in the outcome of results</p> <p>E. Show openness to critical feedback of reports</p> <p>F. Appreciate the importance of keeping up-to-date with developments and with relevant medical literature.</p> <p>G. Show awareness of health and safety issues</p>

*** Optional**

Teaching and Learning Methods 1-6, 8-13 (See Table 1)

CORE IMAGING: GASTROINTESTINAL SYSTEM

Objective. To provide the trainee with the knowledge, skills and attitudes to evaluate gastrointestinal disorders function using radionuclide techniques.

Subject	Knowledge	Skills	Attitudes
VI Hepatobiliary function	<p>A. Clinical spectrum of biliary disorders including knowledge of operative procedures</p> <p>B. Physiology and pathophysiology of bile formation, gallbladder and sphincter of Oddi function.</p> <p>C. Basic science of ^{99m}Tc HIDA derivatives and pharmacology of cholecystokin analogues.</p> <p>D. Use of ^{99m}Tc HIDA or derivatives to evaluate</p> <ul style="list-style-type: none"> ➤ Biliary obstruction ➤ Acute cholecystitis ➤ Biliary leaks ➤ Gallbladder dyskinesia ➤ Sphincter of Oddi dysfunction ➤ Duodenogastric bile reflux <p>E. Alternative methods of assessing the biliary tract.</p> <p>F. Radiation protection issues</p>	<p>A. Preparation of the patient prior to the test.</p> <p>B. Measurement and drawing up of the radiopharmaceutical.</p> <p>C. Choice of imaging protocol and administration of the radiopharmaceutical.</p> <p>D. Performing the scan ensuring good technique and awareness of the pitfalls of the study</p> <p>E. Timing the administration of the gall bladder provocation agent.</p> <p>F. Data processing and quantification of gallbladder function</p> <p>G. Image interpretation and reporting sufficient numbers of patient studies to assess utility, sources of error, normal variants and artefacts.</p> <p>H. Audit</p>	<p>A. Recognise the importance of proper vetting of request forms and of patient evaluation prior to the test.</p> <p>B. Show willingness to provide explanation to patient as to nature of the investigation and to put them at ease.</p> <p>C. Appreciate the importance of timely reporting and of prompt and accurate communication of the result to the referring clinician.</p> <p>D. Consider the importance of audit in the outcome of results</p> <p>E. Show openness to critical feedback of reports</p> <p>F. Appreciate the importance of keeping up-to-date with developments and with relevant medical literature.</p> <p>G. Show awareness of health and safety issues</p>

Teaching and Learning Methods 1-6, 8-13 (See Table 1)

CORE IMAGING: INFECTION/INFLAMMATION

Objective. To provide the trainee with the knowledge, skills and attitudes to evaluate sites of infection/inflammation using radionuclide techniques.

Subject	Knowledge	Skills	Attitudes
Imaging sites of infection or inflammation	<p>A. Basic science of infection/inflammation including cellular mechanisms</p> <p>B. Clinical spectrum of occult sepsis</p> <p>C. Radiopharmaceuticals used for infection/inflammation imaging including ⁶⁷Gallium citrate, ^{99m}TcHMPAO or ¹¹¹Indium autologous white cells, ^{99m}TcHIG and other infection/inflammation imaging agents in current use or in development.</p> <p>D. Indications for use of radioactive tracers to image occult infection or inflammation</p> <p>E. Role of complementary and comparative investigations for the diagnosis of occult infection or inflammation.</p> <p>F. Radiation protection issues</p>	<p>A. Patient preparation.</p> <p>B. Choice of appropriate radiopharmaceutical and imaging protocol.</p> <p>C. Preparation (including cell labelling skills) and administration of the radiopharmaceutical.</p> <p>D. Performing the scans ensuring good technique and developing knowledge of the pitfalls.</p> <p>E. Image processing and display.</p> <p>F. Image interpretation and reporting of sufficient number of patient studies to assess utility, sources of error, normal variants and artefacts.</p> <p>G. Audit</p>	<p>A. Recognise the importance of proper vetting of request forms and of patient evaluation prior to the test.</p> <p>B. Show willingness to provide explanation to patient as to nature of the investigation and to put them at ease.</p> <p>C. Appreciate the importance of timely reporting and of prompt and accurate communication of the result to the referring clinician.</p> <p>D. Consider the importance of audit in the outcome of results</p> <p>E. Show openness to critical feedback of reports</p> <p>F. Appreciate the importance of keeping up-to-date with developments and with relevant medical literature.</p> <p>G. Show awareness of health and safety issues</p>

Teaching and Learning Methods 1-6, 8-13 (See Table 1)

CORE CURRICULUM: LYMPHOSCINTIGRAPHY

Objective. To provide the trainee with the knowledge, skills and attitudes to evaluate regional lymphatic drainage using radionuclide techniques (see common objectives)

Subject	Knowledge	Skills	Attitudes
<p>Lymphoedema evaluation and Sentinel Node Localisation</p>	<p>A. Regional lymphatic anatomy and physiology. B. Mechanisms of tumour spread and concept of the sentinel node. C. Basic science of radiopharmaceuticals used to image regional lymphatic drainage. D. Indications for lymphoscintigraphy. E. Comparative regional lymphatic localisation techniques. F. Radiation protection issues</p>	<p>A. Preparation of the patient prior to the test. B. Choice of radiopharmaceutical. C. Injection techniques. D. Performing the scans ensuring good technique and knowledge of the pitfalls. E. Surface localisation of the sentinel node F. Calibration and use of the hand-held probe. G. Performance and reporting of sufficient number of patient studies to assess utility, sources of error, normal variants and artefacts. H. Audit</p>	<p>A. Recognise the importance of proper vetting of request forms and of patient evaluation prior to the test. B. Show willingness to provide explanation to patient as to nature of the investigation and to put them at ease. C. Appreciate the importance of timely reporting and of prompt and accurate communication of the result to the referring clinician. D. Consider the importance of audit in the outcome of results E. Show openness to critical feedback of reports F. Appreciate the importance of keeping up-to-date with developments and with relevant medical literature. G. Show awareness of health and safety issues</p>

Teaching and Learning Methods 1-6, 8-13 (See Table 1)

CORE IMAGING: ONCOLOGY

Objective. To provide the trainee with the knowledge, skills and attitudes to evaluate cancer using radionuclide techniques (see also PET section).

Objective	Knowledge	Skills	Attitudes
Imaging tumour sites using radionuclide techniques	<ul style="list-style-type: none"> A. Basic science of tumour biology, metabolism, and spread B. Characteristics of solid organ tumours and haematological malignancies. C. Principles of tumour localisation. D. Radiopharmaceuticals currently used to detect tumours (e.g. ^{67}Ga, ^{201}Tl, pentavalent DMSA, radiolabelled antibodies, and peptides) and those in development. E. Indications for radionuclide tumour imaging including sensitivity and specificity of the investigations F. Role of comparative tumour imaging techniques including CT and MR imaging. G. Radiation protection issues 	<ul style="list-style-type: none"> A. Preparation of the patient prior to the test. B. Measurement and drawing up of tracer. C. Injection of the tracer. D. Performing the scan aiming for good technique and awareness of the pitfalls of the study. E. Image reconstruction and display F. Image interpretation and reporting of sufficient number of patient studies to assess utility, sources of error, normal variants and artefacts. G. Review of sequential data on patients and comparison with other methods of assessment H. Audit of outcome 	<ul style="list-style-type: none"> A. Recognise the importance of proper vetting of request forms and of patient evaluation prior to the test. B. Show willingness to provide explanation to patient as to nature of the investigation and to put them at ease. C. Appreciate the importance of timely reporting and of prompt and accurate communication of the result to the referring clinician. D. Consider the importance of audit in the outcome of results E. Show openness to critical feedback of reports F. Appreciate the importance of keeping up-to-date with developments and with relevant medical literature. G. Show awareness of health and safety issues

Teaching and Learning Methods 1-13 (See Table 1)

CORE IMAGING: OPHTHALMIC SYSTEM

Objective. To provide the trainee with the knowledge, skills and attitudes to evaluate nasolacrimal drainage using radionuclide techniques.

Subject	Knowledge and skills	Skills *	Attitudes
<p>NASOLACRIMAL DRAINAGE</p>	<p>A. Physiology and pathophysiology of nasolacrimal ducts. B. Basic science of nasolacrimal drainage using ^{99m}TcO₄. C. Indications for measurement of nasolacrimal drainage. D. Comparative tests. E. Radiation protection issues.</p>	<p>A. Preparation of the patient prior to the test. B. Ocular radiopharmaceutical instillation techniques. C. Performing the scans developing good technique and a knowledge of the pitfalls associated with the study. D. ROI placement and quantification. E. Image interpretation and reporting of sufficient number of patient studies to assess utility, sources of error, normal variants and artefacts. F. Audit.</p>	<p>A. Recognise the importance of proper vetting of request forms and of patient evaluation prior to the test. B. Show willingness to provide explanation to patient as to nature of the investigation and to put them at ease. C. Appreciate the importance of timely reporting and of prompt and accurate communication of the result to the referring clinician. D. Consider the importance of audit in the outcome of results E. Show openness to critical feedback of reports F. Appreciate the importance of keeping up-to-date with developments and with relevant medical literature. G. Show awareness of health and safety issues</p>

* Optional

Teaching and Learning Methods 1-4, 8-11 (See Table 1)

CORE IMAGING: PAEDIATRICS

Objective. To provide the trainee with the knowledge, skills and attitudes to assess disorders in children using radionuclide techniques.

Subject	Knowledge	Skills	Attitudes
Imaging children using radionuclides	<ul style="list-style-type: none"> A. Understanding of growth and maturation in children with special reference to the handling of radiotracers by immature organs. B. Specific indications for radionuclide investigations in children especially of the renal tract, biliary tract and skeleton. C. Comparative diagnostic investigations in children (ultrasound, CT imaging, MR scans etc) D. Knowledge of statutory issues relating to children (e.g. Childrens' Act) E. Principles of consent in children F. Radiation protection issues appropriate to children 	<ul style="list-style-type: none"> A. General preparation of the child for the test. B. Specific preparation of the child for particular tests. C. Choice of radiopharmaceutical dose and imaging protocol appropriate to the child. D. Use of injection techniques appropriate to children. E. Performing each stage of the scan in children. F. Image interpretation and reporting of sufficient number of patient studies to assess utility, sources of error, normal variants and artefacts in children. G. Audit of the outcome of results. 	<ul style="list-style-type: none"> A. Recognise the importance of proper vetting of request forms and of patient evaluation prior to the test. B. Show willingness to provide explanation to patient as to nature of the investigation and to put them at ease. C. Appreciate the importance of timely reporting and of prompt and accurate communication of the result to the referring clinician. D. Consider the importance of audit in the outcome of results E. Show openness to critical feedback of reports F. Appreciate the importance of keeping up-to-date with developments and with relevant medical literature. G. Show awareness of health and safety issues

Teaching and Learning Methods 1-13 (See Table 1)

CORE IMAGING: PULMONARY SYSTEM

Objective. To provide the trainee with the knowledge, skills and attitudes to evaluate pulmonary disorders using radionuclide techniques (see common objectives)

Subject	Knowledge	Skills	Attitudes
I Pulmonary Embolism (PE)	<ul style="list-style-type: none"> A. Clinical risk factors and presentation of PE. B. Basic science of pulmonary perfusion and ventilation C. Indications for and evidence base supporting ventilation perfusion (VQ) imaging D. Principles of perfusion imaging. E. Knowledge of ventilation agents including ¹³³Xenon, ⁸⁹ Krypton, ^{99m}Tc DTPA and Technegas F. Characteristics of aerosol and gas delivery systems. G. Role of comparative imaging techniques including contrast pulmonary angiography and CTPA H. Contribution of D-dimer measurements, leg ultrasound and contrast venography to facilitate diagnosis of PE. I. Radiation protection issues 	<ul style="list-style-type: none"> A. Preparation of the patient prior to the test. B. Choice of radiopharmaceutical and imaging protocol. C. Techniques of radiopharmaceutical injection and inhalation D. Performing the scans ensuring good technique and developing knowledge of the pitfalls. E. Data processing and image display F. Image interpretation and reporting of sufficient number of patient studies to assess utility, sources of error, normal variants and artefacts. G. Audit of outcome 	<ul style="list-style-type: none"> A. Recognise the importance of proper vetting of request forms and of patient evaluation prior to the test. B. Show willingness to provide explanation to patient as to nature of the investigation and to put them at ease. C. Appreciate the importance of timely reporting and of prompt and accurate communication of the result to the referring clinician. D. Consider the importance of audit in the outcome of results E. Show openness to critical feedback of reports F. Appreciate the importance of keeping up-to-date with developments and with relevant medical literature. G. Show awareness of health and safety issues

Teaching and Learning Methods 1-13 (See Table 1)

CORE IMAGING: PULMONARY SYSTEM

Objective. To provide the trainee with the knowledge, skills and attitudes to evaluate pulmonary disorders using radionuclide techniques.

Subject	Knowledge and skills	Skills *	Attitudes
II Regional Ventilation, Mucociliary and Small Solute Clearance	A. Clinical features and management of obstructive pulmonary disease, bronchiectasis and alveolitis. B. Basic science of regional ventilation, the mucociliary escalator and alveolar-capillary membrane integrity C. Principles of aerosol physics D. Characteristics of aerosol delivery systems. E. Indications for measurement of regional ventilation and small solute clearance including evidence base F. Radiation protection issues	A. Preparation of the patient prior to the test. B. Choice of radiopharmaceutical and imaging protocol. C. Techniques of radiopharmaceutical delivery D. Performing the test ensuring good technique and developing knowledge of the pitfalls. E. Data processing, image display and quantification F. Image interpretation and reporting of sufficient number of patient studies to assess utility, sources of error, normal variants and artefacts. G. Audit	A. Recognise the importance of proper vetting of request forms and of patient evaluation prior to the test. B. Show willingness to provide explanation to patient as to nature of the investigation and to put them at ease. C. Appreciate the importance of timely reporting and of prompt and accurate communication of the result to the referring clinician. D. Consider the importance of audit in the outcome of results E. Show openness to critical feedback of reports F. Appreciate the importance of keeping up-to-date with developments and with relevant medical literature. G. Show awareness of health and safety issues

* Optional

Teaching and Learning Methods 1-6, 8-13 (See Table 1)

CORE IMAGING: SKELETAL SYSTEM

Objective. To provide the trainee with the knowledge, skills and attitudes to evaluate the skeletal disorders using radionuclide techniques.

Subject	Knowledge	Skills	Attitudes
I Bone scans	<ul style="list-style-type: none"> A. Anatomy and physiology of the skeleton B. Clinical presentation and management of disorders affecting the skeleton. C. Basic science of ^{99m}Tc diphosphonate bone scans D. Basic science of ^{99m}Tc colloid bone marrow scans E. Indications for bone and marrow scans including understanding of the evidence base F. Use of bone scans in conjunction with other radionuclide imaging to assess bone or peri-prosthetic infections (see section on infection/inflammation) G. Knowledge of imaging protocols including three-phase imaging, whole body or spot planar static imaging and SPECT H. Role of comparative imaging (plain XR, CT and MR scans) for the assessment of skeletal disorders. I. Radiation protection issues 	<ul style="list-style-type: none"> A. Preparation of the patient for and during the test. B. Choice of appropriate imaging protocol. C. Radiopharmaceutical injection D. Performing the test ensuring good technique and developing knowledge of the pitfalls. E. Image reconstruction, display, interpretation and reporting of sufficient number of patient studies to assess utility, sources of error, normal variants and artefacts. F. Audit 	<ul style="list-style-type: none"> A. Recognise the importance of proper vetting of request forms and of patient evaluation prior to the test. B. Show willingness to provide explanation to patient as to nature of the investigation and to put them at ease. C. Appreciate the importance of timely reporting and of prompt and accurate communication of the result to the referring clinician. D. Consider the importance of audit in the outcome of results E. Show openness to critical feedback of reports F. Appreciate the importance of keeping up-to-date with developments and with relevant medical literature. G. Show awareness of health and safety issues

Teaching and Learning Methods 1-13 (See Table 1)

CORE CURRICULUM: SKELETAL SYSTEM

Objective. To provide the trainee with the knowledge, skills and attitudes to evaluate skeletal disorders.

Subject	Knowledge	Skills *	Attitudes
II Bone densitometry	A. Clinical risk factors, presentation and management of osteoporosis. B. Basic physiology and biochemistry of bone metabolism. C. Basic science of DEXA scans and other methods e.g. USS, QCT etc D. Indications for bone densitometry measurements including knowledge of the evidence base E. Quality control F. Radiation protection issues	A. Preparation of the patient for the test. B. Performing the test ensuring good technique and developing knowledge of the pitfalls. C. Data analysis and computation of scan results D. Interpretation of the results E. Ability to give advice with regard to therapy	A. Recognise the importance of proper vetting of request forms and of patient evaluation prior to the test. B. Show willingness to provide explanation to patient as to nature of the investigation and to put them at ease. C. Appreciate the importance of timely reporting and of prompt and accurate communication of the result to the referring clinician. D. Consider the importance of audit in the outcome of results E. Show openness to critical feedback of reports F. Appreciate the importance of keeping up-to-date with developments and with relevant medical literature. G. Show awareness of health and safety issues

* Optional

Teaching and Learning Methods 1-13 (See Table 1)

CORE IMAGING: UROGENITAL SYSTEM

Objective. To provide the trainee with the knowledge, skills and attitudes to evaluate urogenital disorders using radionuclide techniques.

Subject	Knowledge	Skills	Attitudes
Renal and bladder function	A. Basic science associated with the urogenital tract. B. Radiopharmaceuticals used for renal imaging (e.g. DMSA, DTPA and MAG3). C. Principles of dynamic renography D. Computation of differential renal function E. Computation of renal transit/drainage F. The use of interventions such as Frusemide and Captopril G. Urodynamic studies (reflux, cystography) H. Assessment of renal transplants. I. Assessment of testicular torsion and varicoceles J. Role of comparative renal imaging such as ultrasound, CT etc) K. Radiation protection issues	A. Preparation of the patient prior to the test. B. Choice of radiopharmaceutical and imaging protocol. C. Techniques of radiopharmaceutical injection for renal studies D. Performing the scans ensuring good technique and developing knowledge of the pitfalls. E. Data processing, display and quantification F. Image interpretation and reporting of sufficient number of patient studies to assess utility, sources of error, normal variants and artefacts. G. Audit.	A. Recognise the importance of proper vetting of request forms and of patient evaluation prior to the test. B. Show willingness to provide explanation to patient as to nature of the investigation and to put them at ease. C. Appreciate the importance of timely reporting and of prompt and accurate communication of the result to the referring clinician. D. Consider the importance of audit in the outcome of results E. Show openness to critical feedback of reports F. Appreciate the importance of keeping up-to-date with developments and with relevant medical literature. G. Show awareness of health and safety issues

Teaching and Learning Methods 1-13 (See Table 1)

CORE IMAGING: PET SCANNING

Objective. To provide the trainee with the knowledge, skills and attitudes to have a working knowledge of PET scanning

Subject	Knowledge	Skills	Attitudes
I Basic science appropriate to PET Scanning	<ul style="list-style-type: none"> A. Theory of the production and decay of positron radionuclides used in clinical PET B. Compartmental analysis methods C. Appropriate mathematics and physics applied to PET tracer theory, modelling of tracer kinetics and quantitative imaging. D. Radiopharmacy of the tracers used in PET E. Physiological principles of the techniques F. Dosimetry of the various tracers used. G. Legal aspects associated with tracers H. Methods of measurement of tracer activity and scanning equipment I. Errors associated with the quantitative measurements J. Knowledge of gamma camera and dedicated PET systems K. Method of acquiring PET images 		

Teaching and Learning Methods 1-13 (See Table 1)

CORE IMAGING: PET SCANNING

Objective. To provide the trainee with the knowledge, skills and attitudes to have a working knowledge of PET scanning

Subject	Knowledge	Skills	Attitudes
II PET in Oncology	A. Basic science of tumour metabolism B. PET tracers used for tumour detection including FDG and methionine C. Normal variation in tracer distribution in whole body and local views. D. PET in tumour diagnosis e.g. pulmonary nodules. E. PET in tumour staging e.g. lung cancer, lymphoma, germ cell tumours etc. F. PET in the detection of recurrent disease e.g. colorectal cancer. G. Role of PET tracer imaging compared to other imaging methods including CT and MR scans. H. Radiation protection issues	A. Preparation of the patient prior to the test. B. Measurement and drawing up of tracer. C. Injection of the tracer. D. Methods of scanning and data manipulation. E. Image reconstruction and display F. Image interpretation and reporting of sufficient number of patient studies to assess utility, sources of error, normal variants and artefacts. G. Review of sequential data on patients and comparison with other methods of assessment H. Audit of results	A. Recognise the importance of proper vetting of request forms and of patient evaluation prior to the test. B. Show willingness to provide explanation to patient as to nature of the investigation and to put them at ease. C. Appreciate the importance of timely reporting and of prompt and accurate communication of the result to the referring clinician. D. Consider the importance of audit in the outcome of results E. Show openness to critical feedback of reports F. Appreciate the importance of keeping up-to-date with developments and with relevant medical literature. G. Show awareness of health and safety issues

Teaching and Learning Methods 1-13 (See Table 1)

CORE IMAGING: PET SCANNING

Objective. To provide the trainee with the knowledge, skills and attitudes to have a working knowledge of PET scanning

Subject	Knowledge	Skills	Attitudes
III PET in Neuropsychiatry	<ul style="list-style-type: none"> A. Basic neurophysiology, neurochemistry and cross-sectional neuroanatomy. B. PET tracers used for brain imaging. C. Normal variation in PET tracer distribution within the brain. D. Role of PET in the diagnosis of common brain disorders such as epilepsy and dementia. E. PET in the evaluation of brain tumours. F. Role of PET tracer imaging compared to other imaging methods including CT and MR scans. G. Radiation protection issues 	<ul style="list-style-type: none"> A. Preparation of the patient prior to the test. B. Measurement and drawing up of tracer. C. Injection of the tracer. D. Methods of scanning and data manipulation. E. Image reconstruction and display F. Image interpretation and reporting of sufficient number of patient studies to assess utility, sources of error, normal variants and artefacts. G. Review of sequential data on patients and comparison with other methods of assessment H. Audit of results 	<ul style="list-style-type: none"> A. Recognise the importance of proper vetting of request forms and of patient evaluation prior to the test. B. Show willingness to provide explanation to patient as to nature of the investigation and to put them at ease. C. Appreciate the importance of timely reporting and of prompt and accurate communication of the result to the referring clinician. D. Consider the importance of audit in the outcome of results E. Show openness to critical feedback of reports F. Appreciate the importance of keeping up-to-date with developments and with relevant medical literature. G. Show awareness of health and safety issues

Teaching and Learning Methods 1-13 (See Table 1)

CORE IMAGING: PET SCANNING

Objective. To provide the trainee with the knowledge, skills and attitudes to have a working knowledge of PET scanning

Subject	Knowledge	Skills	Attitudes
IV PET in Cardiology	A. Coronary and cardiac anatomy, cardiac physiology and pathophysiology. B. Assessment of myocardial ischaemia using ^{82}Rb , ^{13}N -ammonia, ^{15}O -water.. C. FDG PET for assessment of myocardial viability. D. Control and monitoring of glucose metabolism for FDG injection. E. Principles of pharmacological cardiac stress tests F. Normal variation in FDG tracer distribution within the heart. G. Role of PET tracer imaging compared to other imaging methods including cardiac stress echo and coronary angiography. H. Radiation protection issues	A. Preparation of the patient prior to the test. B. Measurement and drawing up of tracer. C. Performance of cardiac stress testing using pharmacological techniques. D. Injection of the FDG, NH_3 and any new tracers. E. Production of parametric perfusion images and calculation of numeric results F. Image interpretation and reporting of sufficient number of patient studies to assess utility, sources of error, normal variants and artefacts. G. Review of sequential data on patients and comparison with other methods of assessment H. Audit of results	A. Recognise the importance of proper vetting of request forms and of patient evaluation prior to the test. B. Show willingness to provide explanation to patient as to nature of the investigation and to put them at ease. C. Appreciate the importance of timely reporting and of prompt and accurate communication of the result to the referring clinician. D. Consider the importance of audit in the outcome of results E. Show openness to critical feedback of reports F. Appreciate the importance of keeping up-to-date with developments and with relevant medical literature. G. Show awareness of health and safety issues

Teaching and Learning Methods 1-13 (See Table 1)

CORE IMAGING: NON-IMAGING DIAGNOSTICS

Objective. To provide the trainee with the knowledge, skills and attitudes to employ radionuclide non-imaging diagnostic tests in the measurement of human disease.

Subject	Knowledge	Skills	Attitudes
I Glomerular Filtration Rate	A. Physiology and pathophysiology of glomerular filtration (GFR). B. Indications for GFR measurements. C. Methodology of GFR measurements using ^{51}Cr -EDTA or $^{99\text{m}}\text{Tc}$ -DTPA including single and multiple sample techniques and volume of distribution D. Role of comparative methods of measuring GFR E. Radiation protection issues	A. Preparation of the patient prior to the test. B. Preparation and injection of ^{51}Cr -EDTA and timing of blood samples C. Data processing and calculation of GFR including application of mono and bi-exponential fits and surface area correction. D. Assessing the sources of error and reviewing sequential data on patients comparing the outcome with the serum urea and creatinine. E. Audit of results	A. Recognise the importance of proper vetting of request forms and of patient evaluation prior to the test. B. Show willingness to provide explanation to patient as to nature of the investigation and to put them at ease. C. Appreciate the importance of timely reporting and of prompt and accurate communication of the result to the referring clinician. D. Consider the importance of audit in the outcome of results E. Show openness to critical feedback of reports F. Appreciate the importance of keeping up-to-date with developments and with relevant medical literature. G. Show awareness of health and safety issues

Teaching and Learning Methods 1-13 (See Table 1)

CORE IMAGING: NON-IMAGING DIAGNOSTICS

Objective. To provide the trainee with the knowledge, skills and attitudes to employ radionuclide non-imaging diagnostic tests in the measurement of human disease.

Subject	Knowledge	Skills	Attitudes
II Gastrointestinal measurements including B12 absorption, SeHCAT and urea breath tests	A. Basic science of malabsorption B. Methodology and indications for B12 absorption tests C. Methodology and indications for SeHCAT D. Methodology and indications for ¹⁴ C-urea breath tests and other ¹⁴ C tests. E. Comparative tests that are available F. Radiation protection issues	A. Preparation of the patient prior to the test. B. Administration of the radiopharmaceutical C. Collection and measurement of the samples D. Calculation of the results E. Reporting sufficient numbers of studies to assess utility and sources of error. F. Review of sequential data before and after treatment G. Audit of results	A. Recognise the importance of proper vetting of request forms and of patient evaluation prior to the test. B. Show willingness to provide explanation to patient as to nature of the investigation and to put them at ease. C. Appreciate the importance of timely reporting and of prompt and accurate communication of the result to the referring clinician. D. Consider the importance of audit in the outcome of results E. Show openness to critical feedback of reports F. Appreciate the importance of keeping up-to-date with developments and with relevant medical literature. G. Show awareness of health and safety issues

Teaching and Learning Methods 1-13 (See Table 1)

CORE IMAGING: NON-IMAGING DIAGNOSTICS

Objective. To provide the trainee with the knowledge, skills and attitudes to employ radionuclide non-imaging diagnostic tests in the measurement of human disease.

Subject	Knowledge	Skills	Attitudes
III Plasma volume, red cell mass, blood cell survival and ferrokinetic studies*	A. Basic science of red cell mass and survival B. Methodology and indications for red cell mass measurement C. Methodology and indications for red cell survival measurement D. Radiation protection issues	A. Preparation of the patient prior to the test. B. Administration of the radiopharmaceutical C. Collection and measurement of the samples D. Calculation of the results E. Assessment of the sources of error F. Reporting sufficient numbers of studies to assess utility and pitfalls G. Audit of the use the clinician makes of the results	A. Recognise the importance of proper vetting of request forms and of patient evaluation prior to the test. B. Show willingness to provide explanation to patient as to nature of the investigation and to put them at ease. C. Appreciate the importance of timely reporting and of prompt and accurate communication of the result to the referring clinician. D. Consider the importance of audit in the outcome of results E. Show openness to critical feedback of reports F. Appreciate the importance of keeping up-to-date with developments and with relevant medical literature. G. Show awareness of health and safety issues

*** Plasma volume and Ferrokinetic studies (non-core)**

Teaching and Learning Methods 1-13 (See Table 1)

CURRICULUM: THERAPY

Objective. To provide the trainee with the knowledge, skills and attitudes to prescribe, administer and monitor the use of radiopharmaceuticals for therapy.

Subject	Knowledge	Skills	Attitudes
I ¹³¹I therapy for thyrotoxicosis	A. Clinical presentation, and diagnosis of thyrotoxicosis B. Causes of thyrotoxicosis including autoimmune thyroid disease, single toxic thyroid nodule and toxic multinodular goitre etc. C. Drug treatment of thyrotoxicosis. D. Patient selection for ¹³¹ I therapy and awareness of alternative treatment options. E. Statutory and environmental factors governing the use of ¹³¹ I therapy for thyrotoxicosis F. Radiation protection issues	A. Obtaining informed consent for therapy B. Providing appropriate radiation protection instructions to the patient/carer/family members. C. Ability to assess the presence and therapy of dysthyroid eye disease. D. Instructing patient when to stop antithyroid medication. E. Assessing and administering the appropriate activity of ¹³¹ I F. Assessing response to therapy. G. Auditing the outcome of therapy	A. Recognise the importance of proper vetting of request forms and of patient evaluation prior to the test. B. Show willingness to provide explanation to patient as to nature of the investigation and to put them at ease. C. Appreciate the importance of timely reporting and of prompt and accurate communication of the result to the referring clinician. D. Consider the importance of audit in the outcome of results E. Show openness to critical feedback of reports F. Appreciate the importance of keeping up-to-date with developments and with relevant medical literature. G. Show awareness of health and safety issues

***Includes attendance at Thyroid Clinics**

Teaching and Learning Methods 1-13 (See Table 1)

CURRICULUM: THERAPY

Objective. To provide the trainee with the knowledge, skills and attitudes to prescribe, administer and monitor the use of radiopharmaceuticals for therapy.

Objective	Knowledge and skills	Skills	Attitudes
II Radiation synovectomy	<ul style="list-style-type: none"> A. Joint anatomy and pathogenesis of inflammatory arthritis B. Principles of radiation synovectomy using ⁹⁰Ycolloid, ¹⁸⁶Re sulphide and ¹⁶⁹Er citrate. C. Patient selection for radiation synovectomy and awareness of alternative treatment options. D. Knowledge of efficacy and potential complications of treatment. E. Radiation protection issues 	<ul style="list-style-type: none"> A. Obtaining informed consent for therapy B. Providing appropriate radiation protection instructions to the patient/carer C. Measurement and drawing up of radiopharmaceutical. D. Performance of intra-articular injection of the radiopharmaceutical E. Use of intra-articular corticosteroids where appropriate F. Ensuring adequate immobilisation of the injected limb to prevent lymphatic uptake. G. Response and toxicity monitoring. H. Auditing the outcome of therapy 	<ul style="list-style-type: none"> A. Recognise the importance of proper vetting of request forms and of patient evaluation prior to the test. B. Show willingness to provide explanation to patient as to nature of the investigation and to put them at ease. C. Appreciate the importance of timely reporting and of prompt and accurate communication of the result to the referring clinician. D. Consider the importance of audit in the outcome of results E. Show openness to critical feedback of reports F. Appreciate the importance of keeping up-to-date with developments and with relevant medical literature. G. Show awareness of health and safety issues

Teaching and Learning Methods 1-13 (See Table 1)

CURRICULUM: THERAPY

Objective. To provide the trainee with the knowledge, skills and attitudes to prescribe, administer and monitor the use of radiopharmaceuticals for therapy.

Objective	Knowledge	Skills	Attitudes
III ³²P for the treatment of polycythemia rubra vera or essential thrombocythemia	A. Clinical characteristics of polycythemia rubra vera (PRV) and essential thrombocythemia (ET) B. Principles of radiobiology in targeted radionuclide therapy C. Nature of ³² P therapy D. Patient selection for ³² P therapy in PRV and ET including awareness of alternative treatment options. E. Knowledge of efficacy and potential complications of treatment. F. Radiation protection issues	A. Obtaining informed consent for therapy B. Providing appropriate radiation protection instructions to the patient/carer C. Measurement and drawing up of radiopharmaceutical. D. Injection of ³² P. E. Response and toxicity monitoring. F. Auditing the outcome of therapy	A. Recognise the importance of proper vetting of request forms and of patient evaluation prior to the test. B. Show willingness to provide explanation to patient as to nature of the investigation and to put them at ease. C. Appreciate the importance of timely reporting and of prompt and accurate communication of the result to the referring clinician. D. Consider the importance of audit in the outcome of results E. Show openness to critical feedback of reports F. Appreciate the importance of keeping up-to-date with developments and with relevant medical literature. G. Show awareness of health and safety issues

Teaching and Learning Methods 1-13 (See Table 1)

CURRICULUM: THERAPY

Objective. To provide the trainee with the knowledge, skills and attitudes to prescribe, administer and monitor the use of radiopharmaceuticals for therapy.

Objective	Knowledge	Skills	Attitudes
IV Unsealed source therapy for the treatment of locally advanced or metastatic malignant disease.	<p>A. Principles of radiobiology in cancer therapy</p> <p>B. Characteristics of therapeutic radionuclides.</p> <p>C. Tumours which are amenable to treatment with targeted radionuclide therapy.</p> <p>D. Radiopharmaceuticals licensed for targeted therapy including ¹³¹I, ⁸⁹Strontium, ¹³¹IMIBG and ⁹⁰YOctreotide.</p> <p>E. Patient selection including appropriateness of therapy and awareness of alternative treatment options.</p> <p>F. Statutory and environmental factors including radiation protection physics.</p> <p>G. Therapeutic radiopharmaceutical administration systems</p> <p>H. Principles of pre- and post-therapy dosimetry</p>	<p>A. Obtaining informed consent for therapy</p> <p>B. Providing appropriate radiation protection instructions to the patient.</p> <p>C. Patient preparation</p> <p>D. Measurement and drawing up of radiopharmaceutical</p> <p>E. Injection of the radiopharmaceutical using the appropriate administration system.</p> <p>F. Monitoring vital signs post-therapy</p> <p>G. Response and toxicity monitoring.</p> <p>H. Audit of outcomes</p>	<p>A. Recognise the importance of proper vetting of request forms and of patient evaluation prior to the test.</p> <p>B. Show willingness to provide explanation to patient as to nature of the investigation and to put them at ease.</p> <p>C. Appreciate the importance of timely reporting and of prompt and accurate communication of the result to the referring clinician.</p> <p>D. Consider the importance of audit in the outcome of results</p> <p>E. Show openness to critical feedback of reports</p> <p>F. Appreciate the importance of keeping up-to-date with developments and with relevant medical literature.</p> <p>G. Show awareness of health and safety issues</p>

Teaching and Learning Methods 1-13 (See Table 1)

CORE OF CLINICAL EXPERIENCE

1. In Vivo Diagnostic Procedures

Core experience must include responsibility (including indication, performance interpretation) for a sufficient number of various in vivo diagnostic radionuclide procedures. Trainees will be expected to be able to demonstrate competence as well as experience in these procedures.

It is recommended that at least 3000 procedures must be supervised and reported by the trainee, and the quality of these audited. These should include a wide range of pathology, and include paediatric studies. A suggested number for each procedure is as follows:

Clinical System	Number of Studies
a. Central nervous system	150
b. Skeletal system	1000
c. Cardiovascular system (at least 80% SPET perfusion with stress)	500
d. Pulmonary system	300
e. Gastro-intestinal system	150
f. Urogenital system	400
g. Endocrine system	400
h. Haematopoietic and lymphatic system (including sentinel node studies)	70
i. Tumours and inflammation	100
j. Paediatric studies	100
k PET Scanning	100

SPET (Single Photon Emission Tomography) studies where relevant.

It is accepted that trainees develop competence at different rates, so these numbers are not absolute but guidelines for the trainee and trainer to ensure an overall balance in providing both depth and breadth of training.

2. Therapy

Training in therapeutic applications must include clinical evaluation, supervision and follow up of patients having therapeutic doses of radionuclides, including aspects of dosimetry and radiation protection. Trainees will be expected to participate in thyroid clinics (both new patient and follow-up), and may need to attend joint clinics with other disciplines, e.g. oncologists, to gain experience in the less common procedures. As in diagnosis suggested numbers are a guide only.

Number of new therapies

1 Thyroid patients

Benign disease

60

Malignant disease

20

2 Other radionuclide treatments

10

APPRAISAL

An educational supervisor will be appointed to the trainee and will provide regular appraisals (3-4 monthly). This will provide the opportunity to develop a learning plan and the ways to

facilitate the achievement of this plan. The appraisal is confidential unless the trainee and supervisor agree that it can form part of the record. The supervisors will have been trained in appraisal and should have training in educational supervision.

ASSESSMENT

Assessment will be made during training by the educational supervisor in liaison with the clinical supervisor(s). These assessments will form the basis for the annual review. The assessment of trainees will be based upon the standard format of annual reviews, including the penultimate year assessment (PYA) to which particular importance attaches. Full details may be found in the Introduction to the JCHMT handbook. The award of the CCST will be based on satisfactory completion of the entire series of annual assessments.

NUCLEAR MEDICINE TRAINING PROGRAMME

Higher Medical Training in Nuclear Medicine is a four-year training programme. This programme is designed to allow flexibility of provision between individual training centres. Trainees are encouraged to develop areas of special interest and expertise in addition to being trained in the basic core curriculum. However, it must be remembered that for recommendation for the award of a CCST, it is essential that trainees fulfil all the requirements set out in the curriculum. The Specialty Training Committee will supervise individual training programmes. Depending on local circumstances, some experience may be moved between years: e.g. paediatrics and PET could be moved forwards or backwards in the training and need not necessarily be done in year 3.

Radiologists entering the programme with FRCR may be exempt for up to two years, but will need to do at least two years whole time equivalent of clinical training in an approved programme. Such individuals are likely to have an individual training programme, the exact content of which will be determined by the relevant training and experience of the individual at the time of entry. As such they will have to undergo formal assessment on entry and annually thereafter.

Physicians wishing to train also in General (Internal) Medicine and leading to CCSTs in both specialties will need to undertake a combined training programme of six years duration. This will need to be supervised by the training committees of both specialties.

NUCLEAR MEDICINE TRAINING PROGRAMME-YEAR 1

Training objectives

Obtain introduction to basic science, clinical procedures, radiation protection and generics (see below)*

Competency achieved

- Knowledge of understanding of basic sciences
- Ability to supervise and report some simple procedures
- Draw up and inject radiopharmaceuticals
- Perform simple data manipulation
- Basic resuscitation

Training

- Start MSc course or in-house course for theoretical aspects of training.
- Observe diagnostic and therapy procedures
- Receive 'in-house' training
- Clinical procedures
- Basic sciences

Assessment

- Training record
- Trainee's report
- Educational Supervisor's report

*** Generics**

Term used to cover legal and regulatory matters, research & development, management, audit, teaching, communication skills, social, attitudinal/behavioural skills

NUCLEAR MEDICINE TRAINING PROGRAMME-YEAR 2

Training objectives

- Further basic science training
- Achieve competency in certain clinical techniques, including cardiac SPECT SPECT or PET, renal interventional studies, paediatrics
- Become knowledgeable in radiation protection
- Develop generic skills

Competency achieved

- Vetting of requests and selecting appropriate investigations
- Report accurately range of simple diagnostic investigations unsupervised (prior to reports being verified by consultant)
- Perform physical/pharmacological stress testing
- Manage uncomplicated therapy cases e.g. I131 for thyrotoxicosis
- Perform more advanced data manipulation.
- Produce research paper (regionally or nationally)
- Give oral presentation
- Advanced/intermediate resuscitation
- Management of complications following radionuclide administration

Training

- Complete MSc or other course
- Perform clinical studies with varying degrees of supervision
- Review images (brought by radiographer/technical staff)
- Participate in departmental/hospital training programmes (generics)

Assessment

- Training record
- Trainee's record
- Educational Supervisor's report
- Year 2 assessment and MSc-final examination

NUCLEAR MEDICINE TRAINING PROGRAMME – YEAR 3

Training objectives

Complete basic science training
To become competent in most clinical procedures.
To start to develop at least one area of special interest
To improve generic skills

Competency achieved

Select, perform and interpret most diagnostic procedures
Manage most therapeutic procedures, including P32, I131 for thyroid carcinoma, joint and bone palliation, see I131MIBG therapy
Presentation of oral and written data for teaching or research

Training

Receive training and supervision appropriate for the difficulty of the procedure Attend advanced courses/conferences, including formal management training courses.
Spend periods of attachment to other specialised departments e.g. paediatrics, radiology, CT/MRI, PET.

Assessment

Training record
Trainee's assessment
Educational Supervisor's assessment

Penultimate Year Assessment (Year 3) – KEY ASSESSMENT

NUCLEAR MEDICINE TRAINING PROGRAMME – YEAR 4

Training objectives

Complete clinical, scientific and generic training to specialist level
To be knowledgeable of the value of diagnostic and therapeutic procedures in clinical investigation and treatment.

Competency achieved

Fully competent in all clinical areas
To have comprehensive knowledge in basic sciences, dosimetry, and radiation protection
To have well developed generic skills
To have defined area(s) of special interest

Training

Complete clinical training, including experience in more difficult or unusual conditions
Attend appropriate courses/conferences
Complete attachments to specialised units
Travelling fellowship (optional)

Assessment

Training record
Trainer's assessment
Educational Supervisor's assessment

Assessment 4-**Recommendation for CCST**

RADIONUCLIDE RADIOLOGY

1 Summary and recommendations

- 1.1 Appendix A defines the training requirements for trainees in Diagnostic Radiology who wish to develop a special interest in the use of radioactive materials in the diagnosis of disease. Fulfilment of these requirements will enable the trained radiologist to apply for an ARSAC certificate to use the range of radionuclides appropriate for diagnostic imaging.
- 1.2 The additional training requirements needed for the provision of a full nuclear medicine service including therapy with radioactive materials are given. The full six year training programme will be required to enable the radiologists to apply for full ARSAC certificate to include therapeutic procedures. The radiologist who completes this training will obtain dual specialist registration (Radiology and Nuclear Medicine).
- 1.3 This curriculum is divided into four sections: (1) a section of basic knowledge that will normally be undertaken in the first year of training as part of the First FRCR course; (2) a section of clinical radionuclide imaging that will normally be undertaken during the training leading to the Final FRCR; (3) a 12 month period normally undertaken in the 5th* year of the specialist registrar grade; (4) a 12 month period after completion of the radiology training programme in a post approved by the SAC of the Joint Committee on Higher Medical Training (JCHMT) of the Royal Colleges of Physicians.
- 1.4 It should be noted that the curriculum for training solely as a specialist in Nuclear Medicine is provided in the Curriculum *for Higher Specialist Training in Nuclear Medicine*, published by the JCHMT of the Royal Colleges of Physicians (RCP) in December 1998. It should also be noted that dual CCST's in Radiology and Nuclear Medicine can be achieved by pathways other than starting with Radionuclide Radiology, for instance by undergoing training in an integrated dual training programme or by transferring from one training programme to another.
- 1.5 The curriculum for training as a radiologist with a special interest in radionuclide radiology is provided by the Royal College of Radiologists (RCR) and approval for a CCST remain with the RCR.
- 1.6 It is recommended that Radionuclide Radiology training in year 5 be provided in programmes approved jointly by the RCR and RCP. Training in years 1-4 would continue to be supervised solely by the RCR.
- 1.7 It is recommended that there should be at least one SAC approved training centre for nuclear medicine established in each of the 'old' Regions.
- 1.8 It should be possible to approve year 5 training programmes in Radionuclide Radiology in some regions pending the establishment of specialty training programmes in nuclear medicine. It will be possible to provide several year 5 programmes in some regions.
- 1.9 The introduction of Radionuclide Radiology has important implications for manpower planning. There is a need to identify and co-ordinate manpower planning issues for both Radionuclide Radiology and Nuclear Medicine. Throughout this document the phrase "5th year of training" refers to training in the 5th year of training to an equivalent of 12 months taken in modular form during the 4th and 5th years of training

2 Introduction

- 2.1 Nuclear Medicine is the administration of unsealed radioactive substances to patients or volunteers for diagnosis, therapy or research. Nuclear Medicine has been a recognised specialty in the UK since 1976 and in the EC since 1989.
- 2.2 In the UK nuclear medicine procedures are not performed exclusively by nuclear medicine specialists, and a significant number are performed by specialists of other disciplines, often as a sub specialty. The most recent national survey estimated over 50% of procedures were performed by diagnostic radiologists.
- 2.3 The number of nuclear medicine procedures performed shows a continuing increase, and is particularly marked in the more complex procedures such as tomography and cardiology.
- 2.4 Training of medical practitioners responsible for providing nuclear medicine procedures has been very variable. Some have undergone formal training in recognised training programmes, while others have practised after having received little or no formal specialist training. The problem has proven difficult to resolve for a number of reasons, but these have included variable provision of training facilities across the UK and differing attitudes to organising and providing training between the different Medical Royal Colleges involved. The issue of training continues to be a problem and has been a major concern within the specialty and for the authorities responsible for issuing the certification required by statute for giving radioactive substances to patients.
- 2.5 The introduction of specialist training following the Calman Report, and the introduction of the Specialist Medical Order has resulted in a more formal provision of specialist practice in the UK, and a requirement for use of more specific terminology than before. Of relevance to nuclear medicine is the statement of the Specialist Training Authority (STA) that it will not allow a sub-specialty to bear the same title as a recognised specialty, and other criteria must be met for the formal recognition of a sub-specialty.
- 2.6 The Royal College Of Radiologists and the JCHMT recognises that some trainees in radiology may wish to undergo specialist training in nuclear medicine and obtain Completed Certificates of Specialist Training (CCST) in both Nuclear Medicine and also in Clinical Radiology. However, it believes there is also a need to retain the ability for some radiologists to be trained in radionuclide imaging procedures only, and to be able to provide these as part of their clinical radiology service. It has called this sub-specialty Radionuclide Radiology.
- 2.7 The RCR and the JCHMT wishes those practising Radionuclide Radiology to be trained to the same standard as those trained as specialists in Nuclear Medicine, albeit in a more limited area. It wishes that this training can be organised and supervised in such a way as to allow recognition for those wishing to progress to a CCST in Nuclear Medicine to progress with minimal difficulty. To achieve these objectives there is a need for both the RCR and SAC to be involved with overseeing training in Radionuclide Radiology.
- 2.8 The RCR and the JCHMT believes training for Radionuclide Radiology can be provided by a one year programme in a suitably accredited department provided in year 5 of the radiology training programme. This year of training would be in addition to the training in radionuclide procedures covered by all radiology trainees in years 1-4. Those wishing

to proceed to a CCST in Nuclear Medicine would achieve this by undertaking an additional year's training in year 6.

- 2.9 It is recognised that there are other ways of achieving dual CCSTs, e.g. by entering integrated training programmes, or by undertaking a nuclear medicine CCST followed by radiology training.
- 2.10 The SAC recognises there are benefits to be obtained for its trainees by improving integration of training with Clinical Radiology.
- 2.11 This report for the ICSCNM sets out proposals for the Curriculum and supervisory arrangements believed appropriate for training in Radionuclide Radiology and for progression to a CCST in Nuclear Medicine.

3 CURRICULUM

- 3.1 The Curriculum has been set out into four sections and is set out in detail in **Appendix 1A**. Radiologists who undertake the first three sections will attain a standard sufficient to allow supervision of radionuclide imaging. Radiologists who undertake the full training programme will attain a standard sufficient to allow supervision of a full Nuclear Medicine service.
- 3.2 Section 1 will normally be undertaken during the first year as part of First FRCR training. The objective will be to give specialist registrars a basic knowledge of radionuclide techniques including normal appearances and common artefacts.
- 3.3 Section 2 is designed to be undertaken during year 1-4 training as a radiology SpR. The objective is to give specialist registrars sufficient knowledge to understand the principles and indications of common radionuclide techniques and how these relate to other imaging modalities.
- 3.4 Section 3 will require a total of 12 months of training substantially devoted to Radionuclide Imaging. The objective is to give the specialist registrar sufficient knowledge of all aspects of Radionuclide Imaging to allow him/her to manage an imaging service and obtain ARSAC certification for routine imaging procedures. The registrar should undertake at least one piece of prospective or retrospective research.
- 3.5 Section 4 will be undertaken following the award of a CCST in Radiology, in a department of nuclear medicine approved for training by the SAC of the Royal Colleges of Physicians. The objective is to give the specialist registrar full knowledge of non-imaging diagnostic techniques, therapeutic radionuclide procedures and other more specialised techniques carried out in larger centres. This section will require an additional 12 months of full time training, and successful completion will lead to the award of a CCST in Nuclear Medicine and allow application for ARSAC certification for a full range of diagnostic and therapeutic procedures.

4. Supervision of training

- 4.1 The Royal College of Radiologists is responsible for specialist training in Radiology, which includes the training for areas of special interest or subspecialties. The training in radionuclide radiology will remain the responsibility of the RCR within their CCST programme. Training is carried out in RCR approved training programmes, with named

trainers and a regionally developed system of supervision organised in collaboration with the Regional Deans of Postgraduate Medicine. Regional training programmes are normally assessed for approval by the Training and Accreditation Committee (TAC) every four years. Visiting teams are at present constituted by a small number of radiologists and are not designed to be representative of individual sub-specialities of radiology. In future, special interest and subspecialty training with approved curricula will need to be assessed by appropriate specialists, who will join the assessment team for the subspecialty part of the assessment process and be involved in the final discussions about the programme.

- 4.2 The Royal Colleges of Physicians (RCP's) are responsible for specialist training in Nuclear Medicine, and carry out this responsibility through their Joint Committee of Higher Medical Training (JCHMT) and its Specialist Advisory Committees (SACs). Training is carried out in JCHMT approved training programmes which are normally visited every five years. The visiting team is nominated by the SAC and consists of two specialists in nuclear medicine, one of whom is a physician and the other a radiologist by background. The small number of training programmes has required the creation of a National Specialist Training Committee (STCNM) which carries out many of the supervisory functions that are performed at regional level in the larger specialties. The STCNM works closely with the Lead Dean.
- 4.3 It is essential that all radionuclide radiology posts and programmes are recognised by both organisations and therefore the system for recognising training posts and programmes and for the supervision and assessment of trainees needs to be acceptable to both bodies.
- 4.4 The assessment of radionuclide radiology programmes and posts can only be achieved by the SAC in Nuclear Medicine nominating a visitor to inspect this component of the RCR training programme of an individual region, along with an RCR nominated specialist visitor. The Nuclear Medicine visitor on the TAC team would report back to the SAC and the lead Dean in nuclear medicine and the SWNM for their agreement of this recognition. Any changes in curriculum would need to be agreed by the RCR and SAC.
- 4.5 An interim arrangement should be established for regions that wish to establish radionuclide radiology programmes and posts, but who are not likely to be visited by the full visits' team in the immediate future. This will require proper documentation of the programme offered and the qualifications of the trainers. A visit would follow the format whereby a specialist in nuclear medicine appointed by the SAC and one nominated by the TAC of the RCR, would visit the training programme and the proposed post, in conjunction with the Regional Advisers in radiology and nuclear medicine. If the proposal was considered satisfactory, provisional approval could be given, which would be reviewed at the next full appraisal by the Training and Accreditation Committee's team.
- 4.6 Departments currently approved for specialist training in nuclear medicine could also offer training in radionuclide radiology as part of the radiology training programme and would be similarly assessed by the training committee.

4. Assessment of Trainees

- 4.7 Formal reviews of in-training assessment and recommendations of trainees for CCSTs is carried out in radiology at Regional level by the Regional Radiology Specially Training

Committees organised from the Regional Postgraduate Dean's offices, while in nuclear medicine, this task is undertaken by the NMSTC, which reports to the lead dean in nuclear medicine. A joint mechanism is necessary to assess trainees which is acceptable to the RCR for accreditation of a CCST in radiology, with a special interest in radionuclide radiology, and for the RCP for accreditation as part of the CCST in Nuclear Medicine.

- 4.8 It is recommended that radiologists undertaking a year of subspecialty training in radionuclide radiology would be assessed by the Regional Postgraduate Dean and the Specialty Training Committee in Radiology and that assessment should include a nominee from the NMSTC. This must include an assessment at entry, during and at the end of the year, with satisfactory documentation provided. The NMSTC nominee would report back to the Committee, who will review that assessment in order to confirm or reject that the individual has achieved the appropriate level of training, in order that a decision to proceed to the 6th year of training for a Nuclear Medicine CCST may be made if the individual so wishes.

5. Other issues

- 5.1 Distribution of training programmes. At present there are established training programmes in nuclear medicine in 8 of the 'old' Regions in England and Wales, one in Scotland, with others where training approval has lapsed or is pending. There is a need to increase the number of training programmes throughout the UK, and there should be at least one nuclear medicine training centre in each of the 'old' Regions, as was recommended in the 1985 Report of the ICSCNM. It should be possible to approve year 5 training programmes in Radionuclide Radiology in some regions pending the establishment of specialty training programmes in nuclear medicine. It is anticipated that in some regions there will be several training programmes capable of delivering year 5 training.
- 5.2 Training numbers. There remains an unresolved problem concerning training numbers. The current national agreement requires entry to training programmes to be obtained in open competition. This works against the principle of 'seamless' transition identified as desirable for those wishing to progress from Radionuclide Radiology to Nuclear Medicine. This issue requires further discussion between the Colleges and the NHS Executive.
- 5.3 Manpower. The introduction of the Specialist Medical Order and the establishment of the New Specialist Register have resulted in a number of complications for manpower planning. The 1996 survey of the RCP London identified 35 specialists in Nuclear Medicine. The latest figures from the GMC indicate about 200 names on the New Specialist Register as Specialists in Nuclear Medicine. Many of these extra numbers are made up by radiologists who have not undergone specialist training in nuclear medicine, but whose names have been added to the NSR under the 'grandfather' clause. It is not clear how many of these on retirement would be replaced by Radionuclide Radiologists and how many by Nuclear Medicine Specialists. The development of training programmes in Radionuclide Radiology will in itself have manpower implications, as will the continuing national increase in nuclear medicine procedures. There is an urgent need to address these issues for manpower planning.
- 5.4 The introduction of training programmes in Radionuclide Radiology and the necessary changes to the specialty training programme in Nuclear Medicine will require approval from the Specialist Training Authority.

APPENDIX 1A - CURRICULUM

SECTION 1

This section will normally be undertaken as part of the First FRCR training. The objective will be to give specialist registrars a basic knowledge of radionuclide techniques including normal appearances and common artefacts.

SCIENTIFIC PRINCIPLES

Physics

- Atomic structure
- Radioactive decay
- Interaction of radiation with matter
- Biological implications of radiation

Instrumentation

- Principals of radiation detectors
- Nuclear Medicine detectors - gamma cameras (including SPECT), scanners, non-imaging probes, whole body counters, monitoring devices, PET, scintillation counters, dose calibrators
- Collimation

Radiation Biology and Protection

- Biological effects of high and low level radiation
- Calculation of radiation dose from radiopharmaceuticals
- Effective dose equivalent
- ALARA
- ARSAC

Radiopharmacy/Radiochemistry

- Properties of commonly used diagnostic radionuclides
- Principles of localisation of radiopharmaceuticals

CLINICAL

Normal appearances, common artefacts, mode of pharmaceutical uptake, complications etc., of:

- Skeletal (including three phase studies)
- Pulmonary
- Gallium (Ga^{67}) imaging
- Renal (including varieties of renograms)
- Cardiac
- Brain
- Thyroid
- Parathyroid
- Adrenal
- Biliary

Competency achieved

- Knowledge and understanding of Basic Science
- Ability to undertake and supervise simple procedures
- Knowledge and understanding of normal appearances

Assessment

- Trainer's Report
- Trainee's Record
- Annual Assessment
- First FRCR Examination

SECTION II

This section is designed to be undertaken during training for the Final FRCR. The objective is to give specialist registrars sufficient knowledge to understand the principles and indications of common radionuclide techniques and how these relate to other imaging modalities.

Knowledge of Radionuclide Diagnostic Procedures in the following topic areas

- Skeletal Disorders
- Cardiology
- Lung Diseases
- Gastroenterology
- Hepato-Biliary Diseases
- Nephro-Urology
- Neurology and Psychiatry
- Endocrinology
- Haematology
- Oncology
- Infection
- Paediatrics

Including

- All relevant radiopharmaceuticals and imaging devices
- Significance of normal/abnormal findings
- Correlation with other diagnostic tests
- Strengths and weaknesses compared to other imaging modalities
- Preparation of patients, precautions (including drug effects), complications
- Principles of cell labelling

Other Clinical Experience

- Range and limitations

Competency achieved

- Perform clinical studies with appropriate supervision
- Report images under consultant supervision

Assessment

- Trainer's Report
- Log-book
- Annual Assessment
- Final FRCR Examination

SECTION III

This Section will require a total of 12 months of training, of which 90% is devoted to Radionuclide Imaging and 10% to radiology. The objective is to give the specialist registrar sufficient knowledge of all aspects of Radionuclide Imaging to allow him/her to manage an imaging service and obtain ARSAC certification for routine imaging procedures. The registrar should undertake at least one piece of prospective or retrospective research.

Computing and Image Processing

- Principles
- Applications to nuclear medicine data acquisition, processing and display

Radiation Biology and Protection

Diagnosis and treatment of radiation exposure
Management of radiation accidents

Radiopharmacy/Radiochemistry

More detailed knowledge:

- (a) Properties of commonly used diagnostic radionuclides
- (b) Production of radionuclides by reactors, cyclotron and radionuclide generators
- (c) Principles of localisation of radiopharmaceuticals
- (d) Quality control

Clinical Aspects

More detailed knowledge of radionuclide diagnostic imaging and common non-imaging procedures in the following topic areas:

Skeletal Disorders
Cardiology
Lung Diseases
Gastroenterology
Hepato-biliary Diseases
Nephro-Urology
Neurology and Psychiatry
Endocrinology
Haematology
Oncology
Infection
Paediatrics
Other less common applications

Including:

Protocols for study performance and analysis including the use of SPECT.
Preparation of patients, precautions (including drug effects), complications
Special Protocols for paediatric studies
Quality assurance
Significance of normal/abnormal findings
Test evaluation

Sensitivity/specificity/predictive value
Bayes' theorem
Concepts of risks benefit and cost-benefit analysis

Legal/Regulatory Requirements

Including:

Product Licences
Radiopharmacy Aspects
Waste Disposal
Radiopharmaceutical Transport

In accordance with the curriculum of the European Nuclear Medicine Society and the JCHMT of the Royal College of Physicians, the radiologist completing this programme would have been

expected to have supervised and reported a minimum of 3000 procedures. These should include a wide range of pathology and include paediatric studies. The number of procedures in each diagnostic group may vary in line with the accepted efficacy at the time of training but an illustrative number are as follows:

Central Nervous System	30
Skeletal System	1000
Cardiovascular System	500
Pulmonary System	300
Gastrointestinal System	150
Urogenital System	400
Endocrine System	400
Tumours and Inflammation	100

It would be anticipated that approximately 20% of this total would be undertaken in the first 3 years of training and the majority (80%) in the dedicated 12 months of Radionuclide Radiology training. During the 12 months' dedicated training, the trainee radiologist may wish to undertake the imaging modules of an MSc programme or equivalent.

Competency Achieved

Fully competent in the performance and interpretation of all diagnostic areas
 Comprehensive knowledge of science principles, benefits and dangers of Radionuclide Imaging
 To provide a Radionuclide Radiology service in conjunction with all other imaging modalities
 Sufficient knowledge to be granted an ARSAC licence for Radionuclide Imaging

Assessment

Trainer's Report
 Trainee's Logbook
 Final RITA Form
 Recommendations for CCST in Radiology with special interest in Radionuclide Radiology

SECTION IV

This Section will be undertaken following the award of a CCST in Radiology, in a department of nuclear medicine approved for training by the SAC of the Royal Colleges of Physicians. The objective is to give the specialist registrar full knowledge of non-imaging diagnostic techniques, therapeutic radionuclide procedures and other more specialised techniques carried out in larger centres. This section will require 12 months of full-time training, and successful completion will lead to the award of a CCST in Nuclear medicine and allow application for ARSAC certification for a full range of diagnostic and therapeutic procedures.

Knowledge of Radionuclide Therapeutic Principles and Procedures

Mathematics

Probability Theory
 Parametric and non-parametric statistics
 Compartmental Analysis
 Tracer Kinetics

Radiobiology and Protection

Therapeutic implications of radiation over-exposure
Management of therapeutic radioactive accidents

In Vitro Studies

Principles of RIA, ELISA

Therapeutic

Knowledge of Radionuclide therapy in

- Hyperthyroidism
- Thyroid Cancer
- Bone Metastases
- Neural Crest Tumours
- Polycythaemia
- Other soft tissue tumours
- Synovitis

Including

Radiopharmaceuticals and mechanisms of action
Patient selection and preparation
Complications and side-effects
Protection of staff/family etc.
Follow -up care

Diagnostic Studies

- Peptide
- Monoclonal Antibodies
- PET examinations dependent on the dose proximity of a cyclotron
- Non imaging

Research Project

The trainee will be expected to undertake a research project in this year. It is possible that the project may be developed from previous work in the previous 12 month training period. The trainee may also wish to undertake the therapeutic modules of an MSc.

Fig 1 Schema of radiology training

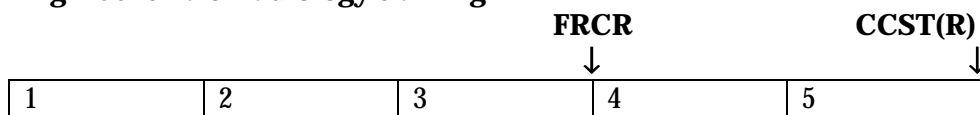
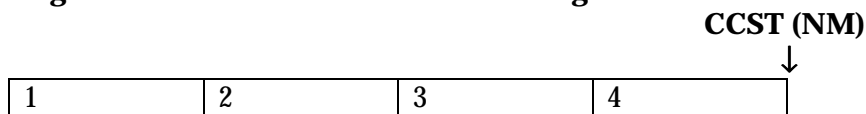


Fig 2 Schema of nuclear medicine training



Methods of radiologists obtaining CCSTs in both radiology and nuclear medicine

Fig 3 Undertake 2 years training in nuclear medicine after completion of radiology CCST total training time 7 years

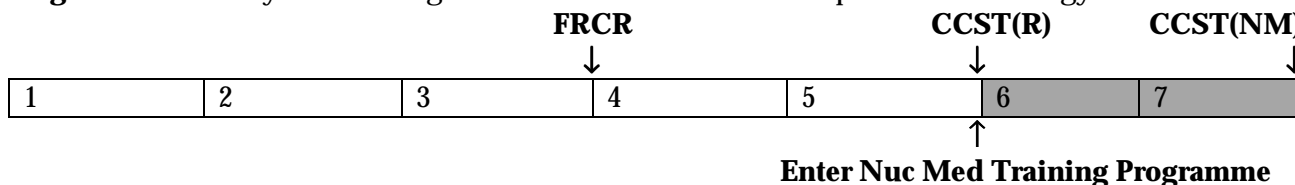


Fig 4 Undertake 1 year radionuclide radiology in year 5 of radiology programme, followed by a further 6th year in nuclear medicine programme. Total training time 6 years

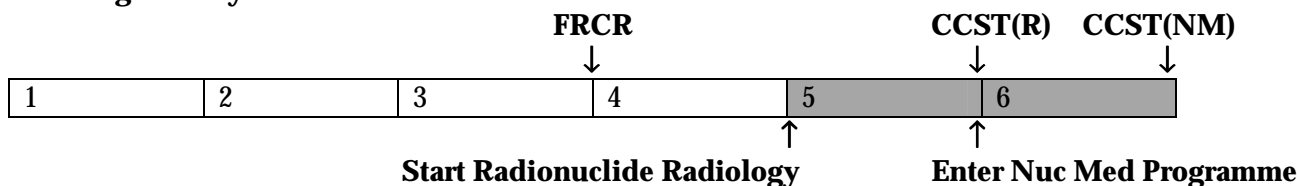


Fig 5 Undertake integrated training programme in years 4 and 5 with additional integrated 6th year. Of these 3 integrated years, two thirds of the time would be spent doing nuclear medicine (i.e. 2 years WTE) and one third doing radiology (i.e. 1 years WTE) Total time 6 years

