

PET-CT SCANNING COMPETENCIES FOR CLINICAL SCIENTISTS & FOR CLINICAL TECHNOLOGISTS/RADIOGRAPHERS

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PET-CT SCANNING COMPETENCIES FOR CLINICAL SCIENTISTS

- For a clinical scientist already possessing the competences to work in nuclear medicine to work unsupervised in PET-CT scanning.
- A clinical scientist not possessing the nuclear medicine competencies would have to acquire these in addition to the PET-CT ones listed here.
- These competencies will not equip the clinical scientist for PET cyclotron operation, radiochemistry or radiopharmacy.
- These competencies will not equip the clinical scientist to work unsupervised in diagnostic radiology.
- Acquisition of the competencies below is necessary but not sufficient for the clinical scientist to act as a Medical Physics Expert (MPE) for PET-CT scanning as defined in IR(ME)R 2000. To act as MPE sufficient appropriate experience is also required.
- The underpinning knowledge component below could be readily be incorporated into current MSc courses. The material could also be taught as a short intensive course (or in future as a 'Higher Specialist Training' course) that would enable existing clinical scientists competent in nuclear medicine to extend their knowledge. The duration of the course would be ~1 week. The practical experience needed to gain the competencies would be obtained via a placement at an established site where the trainee could work under the supervision of a competent member of staff, and produce a portfolio and diary of their placement. Such a training placement would take a minimum of ~6 weeks.
- Both competencies and underpinning knowledge will be assessed by an appropriate senior staff member in the department where the placement takes place.

1. Underpinning knowledge

Scanning technology for PET, CT and PET-CT

Basic principles and scanner configurations

Acquisition parameters and standard clinical protocols including use of CT contrast agents

Image reconstruction, data corrections, image registration

The affects of acquisition/processing parameters

Common image artefacts including PET-CT mis-registration
Performance parameters, performance tests and quality control procedures
CT radiation dosimetry

PET tracer production

Overview of cyclotron principles, configurations and operation
Overview of PET radiochemistry and automation
18F targetry and production
FDG synthesis and quality control procedures
Overview of production of 11C, 15O, 13N, 68Ga, 82Rb, 61/62/64Cu

FDG and other tracers

Biodistribution and pharmacokinetics of FDG
Clinical PET and PET-CT imaging protocols using FDG
Quantification and image analysis for FDG including SUVs, Patlak analysis and input function determination
Introduction to properties and applications of F-, FLT, 15O-water, 13N-ammonia, 11C-methionine, compounds labeled with 68Ga, 82Rb, 61/62/64Cu

Clinical indications

Applications in oncology including lung, lymphoma & colorectal cancer
Cardiac and neuropsychiatric applications
Use of PET for staging, grading, assessing response to therapy & radiotherapy planning
Clinical research and multicentre trials using PET

Regulatory issues

Application of regulations (IRMER 2000, IRR 1999, RSA 93, MARS 1978, Health & Safety at Work Act 1974, RAMROAD 2002, Data Protection Act 1998, Medicines Act 1968, Clinical Trials Directive 2001) to fixed scanning sites, mobile scanning sites, managed services and research studies.

Specification of new installations

Design of static and mobile PET/CT units with respect to regulatory requirements and radiation protection. Reduction of staff exposure and separation of hot/cold zones – required facilities scaled by projected workload and usage, optimal layout for workflow and minimisation of shielding required. Calculations for shielding and validity of input data - workload projections, protocol mix and key assumptions for flexibility in use, dose-rate data, dose constraints and justification for use of these.

2. Practical competencies**Scanning procedures for PET, CT and PET-CT**

Be able to set up and run standard scanning protocols
Be able to set up and run standard image reconstruction and processing protocols
Be able to identify common artefacts and scanner malfunctions and take appropriate action

Be able to perform measurements to determine performance parameters in accordance with NEMA specifications

Be able to set up, perform and document a scanner quality control programme in accordance with establish practice and regulatory requirements

Be aware of PET-CT data formats and be able to facilitate data transfer within and outside the institution in accordance with regulatory requirements

FDG and other tracers

Be able to set up and perform procedures and associated quality control for determination of SUVs and other quantitative indices of tracer uptake

Clinical indications

Have a knowledge of PET-CT indications in oncology, cardiology and neuropsychiatry

Be able to identify normal and common abnormal tracer distribution for standard PET-CT indications

Regulatory issues

Be able to set up and apply compliant standard operating procedures for all relevant regulations (IRMER 2000, IRR 1999, RSA 93, MARS 1978, Health & Safety at Work Act 1974, RAMROAD 2002, Data Protection Act 1998, Medicines Act 1968, Clinical Trials Directive 2001) in the context of fixed scanning sites, mobile scanning sites, managed services and research studies.

Radiation protection

Be aware of the particular radiation protection and shielding issues relating to the use of positron emitting radionuclides at all stages of the PET-CT imaging process, for both fixed and mobile sites, and be able to establish appropriate systems of work.

Be able to estimate the radiation exposure to patients undergoing PET and CT procedures.

Be able to work closely with the RPA in design and commissioning of new installations

Research studies

Be aware of the regulations and guidelines for clinical research studies and collaborative multi-centre clinical trials

**PETCT SCANNING COMPETENCIES FOR CLINICAL
TECHNOLOGISTS/RADIOGRAPHERS**

- These are the competencies that are necessary for a Clinical Technologist/Radiographer who is already competent in nuclear medicine to practice unsupervised as a Clinical Technologist/Radiographer specialising in PETCT scanning.

- It is usual practice that a Clinical Technologist/Radiographer not already competent in nuclear medicine needs to acquire the relevant parts of the nuclear medicine training, before being able to practice unsupervised
- The underpinning knowledge component below could be readily incorporated into current courses such as the BSc (Hons) in Clinical Technology (Physics) and the Post Graduate Diploma in Nuclear Medicine in the future.
- The material could also be taught as a short intensive course that would enable Clinical Technologists/Radiographers already competent in nuclear medicine to extend their knowledge. The duration of the course would be ~1 week. The practical experience needed to gain the competencies would be obtained via a placement at an established site where the trainee could work under the supervision of a competent member of staff, and produce a portfolio and diary of their placement.
- In order to be deemed competent the trainee must have successfully performed at least 75 (seventy-five) patient scans over a period of not greater than 4 months.
- Both competencies and underpinning knowledge should be assessed by an appropriate senior staff member in the department where the placement takes place.

1. Underpinning knowledge

- **Scanner principles and operation**
 - CT, PET and PETCT scanner principles and operation
 - Attenuation Correction for PET and PETCT
 - Image display and fusion
 - Common PET, CT and PETCT image artifacts.
 - Mis-registration of PET & CT images, causes and strategies to reduce them.
- **Radiation protection**
 - Radiation hazards and radiation protection measures for positrons and high energy gamma rays
 - Radiation hazards encountered at all stages of the PETCT imaging process for both fixed and mobile sites
 - Radiation dose implications of CT imaging parameters
- **PET Tracer Production**
 - Outline of cyclotron principles
 - Overview of PET radiochemistry and radiopharmacy
 - Overview of FDG synthesis and quality control procedures
- **FDG**
 - Biodistribution and kinetics of FDG
 - PETCT imaging protocols using FDG
- **Clinical indications**
 - Applications in oncology including lung, lymphoma & colorectal cancer
 - Cardiac and neuropsychiatric applications

- o Use of PETCT for staging, grading, assessing response to therapy & radiotherapy planning
 - o Clinical research and multicentre trials using PETCT
- **Protocols and scheduling**
 - o Protocols for standard oncological, cardiac and brain indications
 - Including the extra requirements for Radiotherapy Planning using PETCT
 - o The importance of optimum appointment scheduling around chemotherapy/radiotherapy & previous surgical interventions
 - o FDG half-life and decay correction in relation to appointment scheduling
 - o To carry out CT part of the study within agreed protocols based on the knowledge, skills, and experience of the Clinical Technologist/Radiographer
- **Legislation relating to Nuclear Medicine**

Have a basic working knowledge of the following legislation as applied to PET-CT

 - o IRMER 2000
 - o IRR 1999
 - o RSA 93
 - o MARS
 - o Health & Safety at Work Act 1974
 - o Data Protection Act

2. Practical competencies

- **PETCT Patient Care**
 - o Patient preparation for an FDG PET Scan
 - Height & weight measurement
 - Details of any Chemotherapy, Radiotherapy, or surgery and why
 - o Measurement of a patients Blood Glucose Level and the implications of a high Blood Glucose Level.
 - o Patient preparation for a diabetic patient and the use of insulin
 - o Administration of sedation & contraindications to the use of
 - o Patient environment during the uptake phase, and the importance of relaxation, room lighting, talking etc.
 - o To have been appropriately trained in intra venous cannulation
- **PET Calibrator Operation**
 - o Be able to safely use the calibrator & to include
 - Perform the daily QC
 - Check for contamination
 - Accurately & safely measure a patient injection
 - Ability to use decay correction tables accurately

- **Preparation of Individual Radiopharmaceutical Activities for PET & Intravenous Injection of ^{18}F Isotopes**
 - confirmation of successful QC release of radiopharmaceutical prior to administration of 1st patient activity according to departmental procedures
 - identification of the patient
 - checking possibility of pregnancy & breastfeeding
 - advice given to patients re: contact with others after their PETCT scan
 - cannulation of the patient
 - preparation of administered activity
 - aseptic technique
 - safe disposal of syringes, needles and other associated consumables
 - documentation
 - use of appropriate syringe guard & radiation dose reduction strategy for the technologist/radiographer
- **PETCT Daily Quality Control Checks**
 - Follow departmental procedures to carry out Daily QC checks & be aware who to report faults to
- **PETCT Console & Gantry Operation**
 - Correctly & safely operate the scanner & associated computer equipment: in particular
 - Know the position of the emergency stop buttons
 - Safely carry out routine scans according to departmental procedures
 - Produce hardcopies as required
 - 2D/3D usage, merits and applications
 - CT acquisition parameters, effect on image quality and radiation dose
 - Use of IV & oral contrast
- **Whole Body PETCT Image Reconstruction and Processing**
 - To be able to identify a normal PETCT scan and also normal variants and commonly seen image artifacts: including
 - PETCT mis-registration, the causes and effect these
 - Artifacts due to CTAC – metal implants and the use of contrast
 - Be able to carry out image reconstruction as required and following departmental policies, to include
 - Attenuation corrected and non-attenuation corrected reconstructions
 - Filtered backprojection and OSEM reconstructions
 - Departmental image processing procedures
- **PETCT Data Archiving**
 - Follow departmental procedures to archive all patient studies
- **PETCT Radiation Protection**

To include :

- o Dealing with spills and personal contamination
- o Contamination monitoring
- o Dealing with radioactive bodily fluids
- o Measures for reducing radiation dose to staff, relatives & carers
- o Administered activity reduction for pediatrics

- **PETCT Patient scans**

- o Performing complete PET-CT scan procedure
- o In order to be deemed competent the trainee must have performed at least 75 (seventy-five) whole body FDG patient scans over a period of not greater than 4 months.