



## TRAINING IN RADIOLOGY

## Vision:

High standards of training in radiology for better patient care using the advanced medical technology.

### برنامج التدريب في الأشعة التشخيصية:

يعتبر تخصص الأشعة التشخيصية من الاختصاصات التي لاقت تقدماً كبيراً، ليس فقط في طرح وتقديم أجهزته تشخيصية جديدة ولكن أيضاً في تقديم تخصصات فرعية جديدة مثل الأشعة التداخلية والطفال وغيرها..... لذلك يجب أن يكون تدريب اخصائي الأشعة على مستوى عال حتى يحصل على المعرفة الأكاديمية مع الإتقان. مدة التدريب هي أربع سنوات يقضيها المتدرب كطبيب مقيم متدرج في المسؤولية في أحد المستشفيات المعترف بها من قبل المجلس الطبي الفلسطيني. إن الغاية من إيجاد شهادة الاختصاص في الأشعة التشخيصية هي تخريج طبيب اختصاصي في هذا المجال قادر على القيام بجميع واجباته كطبيب أشعة على أتم وجه. يتم البدء بالبرنامج التدريبي من السنة الأولى ويتدرج المتدرب حسب الأسس المتبعة بالتدرج .

## DEFINITIONS:

*The following words will have the following meanings unless otherwise specified:*

**Radiology:** Diagnostic Radiology is a branch of medical sciences concerned with the use of radiological and imaging techniques in the diagnosis and treatment of diseases.

**Council:** The Palestinian medical council.

**Committee:** The **scientific** committee of diagnostic radiology in the Palestinian medical council.

**Trainee:** The medical doctor **who accepted** to enter the training program in radiology by the council.

**Department:** radiology department in a recognized hospital.

**Recognized hospital:** a hospital that has been recognized by the medical council for training.

**Program director:** The radiologist who is appointed by the medical council informed to supervise the radiology training in the recognized hospital/ department.

**Trainer:** The radiologist who is accepted in radiology training in the hospital/ department.

## Program director

### 1 – Qualifications

- Radiologist with a higher qualification in radiology.
- Has an experience of 5 years or above after the higher qualification.
- Should have a recognizable experience in teaching and postgraduate training.

### 2 - Responsibilities

- Monitoring of the training program and the trainees.
- Receive, assess and approve the periodic evaluation reports from the trainers
- Ensure the provision and regularity of the scientific training activities.
- Participate in and monitor training activities.
- Participate in the arrangements of the training courses and preparatory courses for the examinations.
- Inspect and approve the trainee's Log Book.

- Be accountable for the actual performance of the trainees
- Provide periodic evaluation reports of the trainee at the end of each academic year.
- Identify potential problems in trainee performance and perform counseling / take the necessary corrective steps.

## **Radiology Trainer:**

### **1 - Qualifications**

- Achieved a high qualification In Radiology.
- Has an experience of at least 5 years after the higher qualification

### **2 - Responsibilities and Duties of the Trainer**

- Responsible for the actual performance of the trainee.
  - Look after the trainee and give him/her the requirements of the training including technical experience with increasing responsibilities according to the trainee's abilities and progress..
  - Organization and delivery of the training and educational activities in collaboration with the head of department.

## **CURRICULUM FOR SPECIALIST**

### **Introduction:**

- 1- Radiology defined as the medical specialty that deals with all aspects of medical imaging that yields information regarding anatomical, physiological and pathological status of a disease. It includes those interventional techniques necessary for diagnosis, as well as minimally invasive therapy, which fall under the scope of departments of clinical radiology.
- 2- It is a basic tenet of the training program that the patient's interest supersedes all other considerations, particularly self-interest, and that at all times the trainee acts with professionalism, integrity and an ethical principle of patient care. Effective communication skills are crucial to this process as well as an ability to act as part of a clinical care team.
- 3- A Radiologist requires a high level of expertise in the following areas:

### **4.1 Basic Sciences:**

- a) Basic physics of image formation, including all those techniques used in radiology departments
- b) Quality control
- c) Radiation protection

- d) Radiation physics
- e) Radiobiology
- f) Anatomy, physiology and techniques referring to radiological procedures
- g) Pharmacology and the administration of contrast media
- h) Basic computer science, molecular biology and biochemistry

#### **4.2 Pathological Sciences**

A knowledge of pathology and pathophysiology relating to diagnostic and interventional radiology

#### **4.3 Current Clinical Practice**

A knowledge of current practice as related to clinical radiology needed as well as a commitment to continuing medical education (CME). Collaboration with clinical colleagues can be through either formal case conferences or informal discussion

#### **4.4 Clinical Radiology**

Radiology knowledge of current clinical radiology practice is required including:

- (a) Organ or system-based specialties specifically cardiac, chest, otorhinolaryngology, abdominal (gastrointestinal and genitourinary), mammography, musculoskeletal, neurology, obstetric and vascular radiology, encompassing all of the imaging modalities: conventional x-rays, contrast studies, angiography, ultrasound, computed tomography (CT), magnetic resonance imaging (MR), and nuclear medicine including positron emission tomography (PET), where applicable.
- (b) Age based specialties e.g. pediatrics
- (c) Common interventional procedures
- (d) On call in emergency situations

#### **4.5 Medicolegal Practice**

**4.6 Research** comprising a knowledge of scientific method necessary for evaluating research publications and promoting personal research

**4.7 Clinical Audit** including a review of uncertainty and error

**4.8 Administration and Management:** an understanding of management of a department of

radiology involving multiple craft personnel groups as well as expensive equipment, and interaction with professional managerial staff

**5 All training will take place in departments accredited by the medical council and reviewed in the regular assessment and visits process by the medical council.**

**6 The period of training is four years of certified general professional training,**

**7 Trainees will be formally examined as follows:**

**Part I exam** is held at the end of the first residency year. Trainees who failed the first attempt can sit for two times after the first one.

**The Final examination** for the medical council held after not less than four years of training in radiology.

**8- Trainees will maintain a record of their training in specifically designed logbooks in digital format using a web-based system, as part of an overall training portfolio.** This logbook to be signed by the program director and the head of department.

## **First Year of Training**

### **Syllabus:**

**1** The first year of training aimed at preparing the trainee for the **Part I** Examination.

- 2 This comprises an introductory course on basic sciences relevant to clinical radiology including **Physics, Radiological Anatomy and Radiological Techniques/ Radiography**. In addition the trainee will be introduced to and begin to acquire some of the practical skills central to the practice of clinical radiology.  
Lectures in physics provided as per the schedule.  
In hospitals the program is delivered locally.
- 3 **At the end of the first year**, the trainee will be expected to have mastered the basic sciences as above, be familiar with the concepts of the multiple imaging modalities used for diagnosis and intervention, as well as their role in general patient care, and understand the responsibility of the radiologist to the patient. The trainee will become competent in the use of contrast agents and drugs, their indications, contraindications, and how to manage adverse reactions. The trainee will be competent in basic cardiopulmonary resuscitation. The trainee will have attained basic competence in all imaging modalities and techniques and have developed basic reporting skills.

## Basic Sciences Course

- 1- Physics includes

**CHAPTER 1 : Radiation physics**, trainee can attend an online course done by the Arab Board or a course arranged by one of the universities in Palestine.

### CHAPTER CONTENTS

- 1.1 Structure of the atom
- 1.2 Electromagnetic radiation
- 1.3 Production of X-rays
- 1.4 The interaction of X- and gamma rays with matter
  - 1.4.1 Attenuation
  - 1.4.2 Compton effect
  - 1.4.3 Photoelectric effect
  - 1.4.4 Relative importance of Compton and photoelectric effects
  - 1.4.5 Secondary electrons and ionization
- 1.5 Filtration
- 1.6 Radiation dosimetry
  - 1.6.1 Absorbed dose
  - 1.6.2 Kerma
  - 1.6.3 Measurement of X- and gamma ray dose
  - 1.6.4 Radiation quantity and quality
- 1.7 Luminescence

## 1.8 Summary

# CHAPTER 2 : Radiation Hazards and Protection

## CHAPTER CONTENTS

- 2.1 Ionizing radiation interactions with tissue
- 2.2 Radiation doses and units
- 2.3 Effects of radiation
  - 2.3.1 Deterministic effects
  - 2.3.2 Stochastic effects
  - 2.3.3 Population dose
- 2.4 Principles of radiation protection
  - 2.4.1 Justification
  - 2.4.2 Optimization
  - 2.4.3 Dose limitation
  - 2.4.4 UK legislation
- 2.5 The Ionising Radiations Regulations 1999
  - 2.5.1 General requirements
  - 2.5.2 Dose limits
  - 2.5.3 Designation of areas and control of working practices
  - 2.5.4 Equipment
  - 2.5.5 Classification of staff and dose monitoring
  - 2.5.6 Radiation incidents
  - 2.5.7 Personal protective equipment
- 2.6 Ionising Radiation (Medical Exposure)
  - 2.6.1 Justification and optimization
  - 2.6.2 Duties of the employer
  - 2.6.3 Other requirements of IRMER
- 2.7 Other legislation
  - 2.7.1 Radioactive Substances
  - 2.7.2 Medicines (Administration of Radioactive Substances) Regulations
- 2.8 Practical aspects of radiation protection
  - 2.8.1 Protection of staff
  - 2.8.2 Protection of the patient
  - 2.8.3 Patient doses and dose assessment

# CHAPTER 3 : Imaging with X-rays

## CHAPTER CONTENTS

- 3.1 Image quality
  - 3.1.1 Contrast
  - 3.1.2 Spatial resolution

- 3.1.3 Noise
- 3.2 Attenuation of X-rays by the patient
  - 3.2.1 Image contrast
  - 3.2.2 Patient dose
- 3.3 Effect of scattered radiation
  - 3.3.1 Scatter reduction and contrast improvement
- 3.4 Secondary radiation grids
  - 3.4.1 Grid construction
  - 3.4.2 Effect on scattered rays
  - 3.4.3 Effect on direct rays
- 3.5 Magnification and distortion
- 3.6 Unsharpness and blurring
- 3.7 Limitations of the X-ray tube
  - 3.7.1 Focal spot size
  - 3.7.2 Rotating anode tube
  - 3.7.3 Heat rating
  - 3.7.4 Uniformity of the X-ray beam
  - 3.7.5 Quality assurance of exposure parameters

## **CHAPTER 4 : Film–Screen Radiography**

### **CHAPTER CONTENTS**

- 4.1 Film–screen radiography: image formation
  - 4.1.1 Film
  - 4.1.2 Intensifying screens
  - 4.1.3 The film cassette
- 4.2 Characteristic curve
- 4.3 Film–screen sensitivity
  - 4.3.1 Intensification factor
  - 4.3.2 Speed class
- 4.4 Radiographic image quality
  - 4.4.1 Contrast
  - 4.4.2 Screen unsharpness
  - 4.4.3 Noise
- 4.5 Film–screen radiography in practice
- 4.6 Mammography
  - 4.6.1 Target and filter materials
  - 4.6.2 Film–screen systems for mammography
  - 4.6.3 The mammography unit
  - 4.6.4 Dose
  - 4.6.5 Magnification films
- 4.7 Linear tomography



#### 4.8 Summary

### CHAPTER 5 : Digital Radiography

#### CHAPTER CONTENTS

- 5.1 Digital imaging
  - 5.1.1 Image structure and size
  - 5.1.2 Image processing
  - 5.1.3 Image display
- 5.2 Imaging terminology
  - 5.2.1 Fourier analysis, sampling and aliasing
  - 5.2.2 Modulation transfer function
- 5.3 Computed radiography
  - 5.3.1 Imaging plates and readers
  - 5.3.2 Computed radiography image processing
  - 5.3.3 Computed radiography image quality
  - 5.3.4 Detector dose indicators
- 5.4 Digital radiography
- 5.5 Picture archiving and communication systems

### CHAPTER 6 : Fluoroscopy

#### CHAPTER CONTENTS

- 6.1 The image intensifier
- 6.2 TV system
- 6.3 Automatic brightness control
- 6.4 Dose rates
- 6.5 Recorded images
- 6.6 Image quality
- 6.7 Digital subtraction angiography
- 6.8 Flat plate detectors
- 6.9 Summary

### CHAPTER 7: Computed Tomography

#### CHAPTER CONTENTS

- 7.1 Introduction
  - 7.1.1 The computed tomography image
  - 7.1.2 Image display
- 7.2 Equipment for computed tomography scanning
  - 7.2.1 X-ray tube
  - 7.2.2 Collimation and filtration
  - 7.2.3 Detectors
- 7.3 Image reconstruction
- 7.4 Helical and multislice scanning
  - 7.4.1 Helical scanning

- 7.4.2 Multislice scanners
- 7.5 Image quality
  - 7.5.1 Spatial resolution
  - 7.5.2 Noise
- 7.6 Image artefacts
- 7.7 Dose
  - 7.7.1 Dosimetry parameters
  - 7.7.2 Factors influencing patient dose

## **CHAPTER 8 : Gamma Imaging**

### **CHAPTER CONTENTS**

- 8.1 Radioactivity
- 8.2 Radioactive transformation (decay)
- 8.3 Radiopharmaceuticals
- 8.4 Planar imaging
- 8.5 Tomography with radionuclides
  - 8.5.1 Single-photon emission computed tomography
  - 8.5.2 Positron emission tomography
- 8.6 Characteristics and quality assurance of gamma images
- 8.7 Dose to the patient
- 8.8 Precautions necessary in handling radionuclides

## **CHAPTER 9 : Ultrasound Imaging**

### **CHAPTER CONTENTS**

- 9.1 Piezoelectric effect
- 9.2 Interference
- 9.3 Single transducer probe
- 9.4 Behavior of a beam at an interface between different materials
- 9.5 Attenuation of ultrasound
- 9.6 A-mode (amplitude mode–echo ranging)
- 9.7 B-mode (brightness mode imaging)
- 9.8 Real-time imaging
  - 9.8.1 Scanners
  - 9.8.2 Contrast agents
  - 9.8.3 Harmonic imaging
  - 9.8.4 Three-dimensional imaging
- 9.9 Image acquisition and reconstruction
- 9.10 Resolution
- 9.11 Artefacts
- 9.12 M-mode scanning (time–motion)
- 9.13 Doppler methods

- 9.13.1 Continuous wave Doppler
- 9.13.2 Pulsed Doppler: range gating
- 9.13.3 Real-time colour flow imaging
- 9.13.4 Power Doppler
- 9.14 Quality assurance
- 9.15 Safety considerations

## **CHAPTER 10 : Magnetic Resonance Imaging**

### **CHAPTER CONTENTS**

- 10.1 The spinning proton
- 10.2 The magnetic resonance signal
- 10.3 Spin–echo sequence
- 10.4 Spatial encoding
- 10.5 Other pulse sequence and imaging techniques
- 10.6 Specialized imaging techniques
- 10.7 Magnetic resonance image quality
- 10.8 Artefacts
- 10.9 Quality assurance
- 10.10 Magnets and coils
- 10.11 Hazards and safe practice

### **References**

1. The Essential Physics of Medical Imaging ( Third Edition )
2. Christensen's Physics of Diagnostic Radiology ( Fourth Edition )
3. Farr's Physics for Medical Imaging (Second Edition)

## **2- Radiological Anatomy**

The syllabus aims towards a high level of expertise in knowledge of regional anatomy relevant to practice for each body system: It is important that trainees will have a firm grasp of normal anatomical variants.

- Thorax, including heart, lungs and chest wall
- Abdomen including the gastrointestinal system, liver, pancreas and biliary tract
- Pelvis including the genitourinary system
- Musculoskeletal system including skeletal development

- Brain
- Head & Neck including skull base, face and teeth
- Vascular including arterial, venous and lymphatic systems
- Breast
- Normal fetal radiology

### 3- Radiological procedures and radiography

The syllabus aims to a high level of knowledge in the key radiological and radiographic techniques relevant to a systems and age based practice.

- Gastrointestinal examinations
- Genitourinary system techniques
- Arthrography
- Arteriography and venography, basics.
- Basic interventional procedures: biopsy, abscess drainage, nephrostomy, angioplasty
- Catheters, needles, guide wires
- Contrast agents.
- Other pharmacological agents e.g. sedatives, muscle relaxants
- Procedures in pediatric radiology
- Procedures in critically ill patients
- Procedures in the breast e.g. needle localization, biopsy
- General radiography comprising the routine, accessory and supplementary examinations needed to cover the anatomy of the skeleton and contrast examinations. These should include positioning, centering and exposure factors.

### Clinical Radiology Activity

- 1- **These activities parallel the Basic Science course throughout the first year.** Individual departments will differ but rotations within departments allow the trainee to spend time in all relevant areas. In addition, the trainee will participate fully in the clinical radiology activity of the department to acquire a good knowledge of best radiological practice. **They will actively participate in the clinicoradiological meetings, internal departmental meetings, journal clubs, grand rounds etc.** Activities **below** which are considered optional objectives in first year are considered core objectives in subsequent training years, reflecting the reiterative revisiting inherent in this longitudinally integrated spiral curriculum.

2 Clinical activity will include a minimum of two sessions per week devoted to reporting. This should be performed under the supervision of a recognized trainer with his/her signature on the report.

This will include as core:

- All of the procedures performed by the trainee
- Trauma radiographs
- In and out patient radiography

**Optional activities include**

- Reporting of special procedures performed by the trainee
- Reporting of ultrasound, CT and MRI examinations overseen by the trainee.

**3 At the end of the first year, the trainee should be in a position to pass the Part I Palestinian Medical Council examination.**

The aim of the appraisal is to verify the trainee's experience and competence gained during the preceding year and to review progress and professional development. Identify any deficiencies in expected knowledge.

**The trainee must submit an attendance of the physics course held in the medical council or other recognized center with the application form for part I examination.**

**The trainee must have an administrative assessment form signed by the head of department including the attendance, attendance of the lectures and seminars as well as general attitude of the trainee with his colloques, technicians, seniors and other doctors in the hospital.**

**Then assessment formalized by jointly completing the assessment form between trainee and assessors.**

If the trainee has passed the first exam he/she is in good standing, will progress to the second year. If the trainee has not passed the part I examination, then he will still be allowed to progress as long as his assessments have been satisfactory.

**PART I Examination –**

- 1 Two sittings per year as stated by the medical council.
- 2 MCQ Physics, Radiological Anatomy / Techniques /positioning.

**Form 1**

**Radiology performance, *to be filled and presented to the head of the department.***

**Name of trainee:**

**Hospital:**

**Date of assess:**

**Date of start of training:**

**Name of assessor:**

**Head of department:**

	<b>Deficient Score 1-4</b>	<b>Borderline Score 5</b>	<b>Satisfactory Score 6</b>	<b>Excellent Score 7-8</b>	<b>Score</b>
<b>Palin films</b>					
<b>Contrast procedures</b>					
<b>Ultrasound</b>					
<b>CT scan</b>					
<b>Communication</b>					
<b>Attendance</b>					
<b>Total score</b>					

**Decision of the HOD:**

**Signature of HOD:**

**(Second, Third- and Fourth-year training)**

## Syllabus

1 During these years trainees will receive practice-based structured training to allow satisfactory experience and experiential learning in all constituent areas of clinical radiology, including systems-based, modality-based and age-based disciplines. A mixture of didactic and practical training as well as a strong core of self-directed learning achieve this. While individual department's structures will dictate specific rotations, the following time course over the 3-year period is a guideline. The trainee will receive increasing responsibilities as he/she progresses through the stages from base knowledge to evaluation.

- Musculoskeletal radiology and trauma
- Thorax including
- Cardiac Imaging
- Abdominal imaging (Gastrointestinal imaging & genitourinary imaging)
- Neuroradiology
- Vascular imaging
- Pediatric imaging
- Head and neck imaging including dental
- Basic interventional techniques
- Breast imaging

**The period to spend in each modality depends on the department but suggested for the trainee to have two months in each in the second and third years while it suggested having three months in each modality in the fourth year.**

As a suggestion and if applicable, by the end of the 4<sup>th</sup> year and two months before the final exam there **will be a departmental mock examination with a viva**, short and long cases held.

2- It is recognized that individual departments will, because of their makeup, differ from each other in how their trainees' needs are met in this respect. For the purposes of elucidating the curriculum, this document concentrates on the organ-based imaging classification. Certainly considerable overlap will occur between modality and organ based training but implicit in this flexibility is an understanding that the trainee will receive training in all of the core objectives and most of the optional objectives during their training time.

3- Specific numbers of cases not to be dictated in the syllabus as being appropriate to the level of training achieved. Obviously, this situation will evolve as the years and practice develops but individual trainee logbooks be used to monitor their progress in given areas.

- 9- On call rota for out of hours work is a crucial part of this process and while individual departments will have their own arrangements, a formalized Rota should in principle include all trainees.

- 10-** Trainees in Radiology will develop knowledge of the radiological signs and techniques in line with the criteria outlined **below**. It is expected that the trainee will be able to offer advice regarding appropriate examinations in given clinical scenarios and be up to date with knowledge of current radiation protection legislation. They will be capable of reporting plain radiographs as part of the normal working of a Radiology Department including participation in a hot reporting system. In light of development in information technology the trainee will be competent at reviewing images displayed on workstations as well as being capable of image manipulation and post processing. The trainee will be capable of performing routine radiologic procedures during the normal working day, and performing and reporting out of hours investigations corresponding with the level of training. Trainees will develop expertise at the organization and presentation at departmental clinico-radiological meetings.
- 6-** Trainees during the four year training should be restricted to their training departments and not be allowed to work or practice independently outside the training departments for any other reason. Any violation to this rule the trainee may lose his/ her training for a limited period ranging from 6 months to one year depending on the decision of the radiology committee in the medical council.
- 7-** Annual assessment to be in the department with the result of each exam to send to the medical council. The examination format done in the same way it done in the council; written part and then film viewing, then viva and film reporting session.

### **Body Imaging**

- Knowledge of gastrointestinal anatomy and clinical practice relevant to clinical radiology
- Knowledge of the radiological manifestations of disease within the abdomen on conventional radiography, contrast studies (including ERCP), ultrasound, CT, MRI, radionuclide investigations and angiography
- Knowledge of the applications, contraindications and complications of relevant interventional procedures.
- Reporting plain radiographs performed to show gastrointestinal disease



- Performing and reporting the following contrast examinations: - swallow and meal examinations, including assessment of esophageal motility - small bowel studies - colonic evaluation by enema and/ or CT colonography techniques
- Performing and reporting transabdominal ultrasound of the gastrointestinal system and abdominal viscera
- Supervising and reporting computed tomography of the abdomen
  - Performing: - ultrasound-guided biopsy and drainage - computed tomography-guided biopsy and drainage Core Experience
- Performing and reporting the following contrast medium studies: - cholangiography (T-tube) - sinography
- Experience of the manifestations of abdominal disease on MRI.

### **Hepatobiliary system**

- Knowledge of the current application of radionuclide investigations to the gastrointestinal tract in the following areas:
  - Liver - biliary system
  - Gastrointestinal bleeding (including Meckel's diverticulum)
  - Abscess localization
- Observation and Knowledge of the application of **angiography and vascular interventional techniques to this subspecialty**
- Observation and Knowledge of the relevant application of the following interventional procedures:
  - **Percutaneous abscess drainage**
  - **Percutaneous biliary drainage and stenting**
  - **Percutaneous cholecystostomy.**
  - **Embolization in acute GI bleeding - percutaneous gastrostomy**
- Observation of colonoscopy, ERCP, balloon dilatation of the esophagus/ stent insertion and other diagnostic and therapeutic endoscopic techniques
- Balloon dilatation of the esophagus/ stent insertion
- Familiarity with performance and interpretation of the following contrast studies:
  - Proctogram

### **Uroradiology**

- Knowledge of urinary tract anatomy and clinical practice relevant to clinical radiology
- Knowledge of the manifestations of urological disease as demonstrated on conventional radiography, ultrasound, CT and MR
- Familiarity with the current application of radionuclide investigations for imaging the following: - kidney - renal function - vesico-ureteric reflux
- Awareness of the application of angiography and vascular interventional techniques Core Skills
- Reporting plain radiographs performed to show urinary tract disease
- Performing and reporting the following contrast studies:
  - Intravenous urogram
  - Retrograde pyelo-ureterography
  - Nephrostogram
  - Ascending urethrogram - micturating cysto-urethrogram
- Performing and reporting transabdominal ultrasound to image the urinary tract
- Supervising and reporting computed tomography of the urinary tract
- Magnetic resonance imaging applied to the urinary tract
- Knowledge of angiography and vascular interventional techniques
- Experience of antegrade pyelo-ureterography Optional Experience

### **Breast Imaging**

- Knowledge of breast pathology and clinical practice relevant to clinical radiology
- Understanding of the radiographic techniques employed in diagnostic mammography
- Understanding of the principles of current practice in breast imaging and breast cancer screening
- Awareness of the proper application of other imaging techniques to this specialty (e.g. ultrasound, magnetic resonance imaging)
- Mammographic reporting of common breast disease.
- Participating in mammographic reporting sessions (screening and symptomatic)
- Observation of breast biopsy and localization Optional Experience

### **Cardiac Imaging**

- Knowledge of cardiac anatomy, and clinical practice relevant to clinical radiology

- Knowledge of the manifestations of cardiac disease demonstrated by conventional radiography
- Familiarity with the application of the following techniques:
  - Magnetic resonance imaging
  - Cardiac computed tomography including CT coronary angiography
- Reporting plain radiographs performed to show cardiac disease.

### **Chest Imaging**

- Knowledge of respiratory anatomy and clinical practice relevant to clinical radiology
- Knowledge of the manifestations of thoracic disease as demonstrated by conventional radiography and CT (including CT Pulmonary angiography)
- Knowledge of the application, risks and contraindications of the technique of image-guided biopsy of chest lesions.
- Reporting of plain radiographs performed to show chest disease
- Supervising and reporting computed tomography of the chest, including high resolution examinations and CT pulmonary angiography
- **Performing and or assisting in Drainage of pleural space collections under image guidance, optional experience.**
- Observation of image-guided biopsies of lesions within the thorax
- Familiarity with the applications of the following techniques: - magnetic resonance imaging - angiography Optional Experience
- Supervising and reporting magnetic resonance imaging

### **Head and Neck Imaging Including ENT/Dental Imaging**

- Knowledge of head and neck anatomy and clinical practice relevant to clinical radiology
- Knowledge of the manifestations of ENT as demonstrated by conventional radiography, relevant contrast examinations, ultrasound, CT and MRI.
- Awareness of the application of ultrasound with particular reference to the thyroid and salivary glands and other neck structures
- Reporting plain radiographs performed to show ENT.
- Performing and reporting relevant contrast examinations (e.g. barium studies including video swallows and knowledge of sialography and dacrocystography)

- Performing and reporting ultrasound of the neck (including the thyroid, parathyroid and salivary glands)
- Supervising and reporting computed tomography of the head and neck for ENT problems.
- Supervising and reporting computed tomography for orbital problems
- Supervising and reporting magnetic resonance imaging in of the head and neck for ENT problems

### **Musculoskeletal Including Trauma Imaging**

- Knowledge of musculoskeletal anatomy and clinical practice relevant to clinical radiology
- Knowledge of normal variants of normal anatomy, which may mimic trauma
- Knowledge of the manifestations of musculoskeletal disease and trauma as demonstrated by conventional radiography, CT, MRI, contrast examination and ultrasound.
- Reporting plain radiographs relevant to the diagnosis of disorders of the musculoskeletal system including trauma
- Supervising and reporting computed tomography of the musculoskeletal system
- Supervising and reporting magnetic resonance imaging of the musculoskeletal system
- Knowledge of ultrasound of the musculoskeletal system
- Supervising CT and MR of trauma patients.
- Knowledge of the relevant contrast examinations (e.g. arthrography) Optional Experience
- Observation of image-guided bone biopsy

### **Neuroradiology Imaging**

- Knowledge of neuroanatomy and clinical practice relevant to neuroradiology
- Knowledge of the manifestations of CNS disease as demonstrated on conventional radiography, CT, MRI, myelography and angiography
- Awareness of the applications, contraindications and complications of invasive neuroradiological procedures
- Familiarity with the application of CT and MR angiography in neuroradiology
- Reporting plain radiographs in the investigation of neurological disorders
- Supervising and reporting cranial and spinal computed tomography
- Supervising and reporting cranial and spinal magnetic resonance imaging
- Performing of carotid ultrasound including Doppler

- Experience in MR angiography and CT angiography to image the cerebral vascular system
- Performing and reporting transcranial ultrasound
- Knowledge of magnetic resonance spectroscopy

### **Obstetrics and Gynecology Imaging**

- Knowledge of obstetric and gynecological anatomy and clinical practice relevant to clinical radiology
- Knowledge of the physiological changes affecting imaging of the female reproductive organs
  - Knowledge of the changes in fetal anatomy during gestation and the imaging appearances of fetal abnormality
- Awareness of the applications of magnetic resonance imaging in gynecological disorders and obstetrics
  - Reporting plain radiographs performed to show obstetric and gynecological disorders
  - Performing and reporting transabdominal ultrasound in gynecological disorders
  - Supervising and reporting computed tomography in gynecological disorders
  - Supervising and reporting magnetic resonance imaging in Gynecological disorders Core Experience
  - Performing and reporting hysterosalpingography, optional.
- Supervising and reporting magnetic resonance imaging in obstetric applications (e.g. assessing pelvic dimensions).

### **Oncology Imaging**

- Knowledge of clinical practice relevant to clinical radiology
- Familiarity with tumor staging nomenclature
- familiarity with the application of ultrasound, computed tomography and magnetic resonance imaging, and interventional techniques in oncological staging, management and monitoring the response of tumors to therapy
  - Familiarity with the radiological manifestations of complications, which may occur in tumor management
- Familiarity with the role of Interventional oncologic procedures

- reporting plain radiographs performed to assess tumors
- Performing and reporting ultrasound, CT, MRI in oncological staging and monitoring the response of tumors to therapy
- Performing image-guided biopsy of masses under US and CT guidance Optional Experience
- 

### **Pediatric Imaging**

- Knowledge of pediatric anatomy and clinical practice relevant to clinical radiology
- Knowledge of disease entities specific to the pediatric age group and their clinical manifestations relevant to clinical radiology
- Knowledge of disease entities specific to the pediatric age group and their manifestations as demonstrated on conventional radiography, ultrasound, contrast studies, CT, MRI.
- Reporting radiographs performed in the investigation of pediatric disorders including trauma
- Identification of suspected non-accidental injury
- Performing and reporting ultrasound in the pediatric age group in the following areas: - transabdominal - transcranial - pediatric hip ultrasound
- Performing and reporting routine fluoroscopic procedures in the pediatric age group, particularly: - contrast studies of the urinary tract - contrast studies of the gastrointestinal system
- Prioritization, protocoling, supervising and reporting computed tomography and magnetic resonance imaging investigations in the pediatric age group
- Special requirements for radiation safety and contrast material dosage for the pediatric population
- Principles of sedation in pediatric radiology Optional Experience
- The practical management of the following pediatric emergencies: - meconium ileus - intussusception

### **Vascular and Vascular Intervention Imaging**

- Knowledge of vascular anatomy and clinical practice relevant to clinical radiology
- Familiarity with the indications, contraindications, pre-procedure preparation (including informed consent), sedation and anesthetic regimes, patient monitoring during procedures and post-procedure patient care
- Familiarity with procedure and post-procedure complications and their management

- Familiarity with the appropriate applications of the following techniques:
    - Ultrasound (including Doppler)
  - Reporting plain radiographs relevant to cardiovascular disease
  - Performing the following techniques:
    - Ultrasound (including Doppler), venous and arterial
  - Supervising and reporting CT examinations of the vascular system (CTA) including image manipulation
  - supervising and reporting MRI examinations of the vascular system (MRA) including image manipulation
- Optional Experience

### **Computed Tomography**

- Knowledge of the technical aspects of performing computed tomography (CT), including the use of contrast media.
- Knowledge of cross-sectional anatomy as visualized on computed tomography
- Practical experience in supervision including vetting requests, determining protocols, the examination, and post processing and reporting of the examination in the following anatomical sites:
  - Brain
  - Head and neck
  - Chest
  - Abdomen and
  - Musculoskeletal
  - Vascular

Knowledge of computed tomography-guided procedures, e.g. biopsy and drainage

- Familiarity with the application of CT angiography
- Familiarity with post image acquisition processing NB: these examinations may be performed during a system-based attachment, e.g. neuroradiology, or during a computed tomography attachment.

### **Magnetic Resonance Imaging**

- Understanding of current advice regarding the safety aspects of magnetic resonance imaging (MRI)
- Knowledge of the basic physical principles of magnetic resonance imaging, including the use of contrast media
- Knowledge of the cross-sectional anatomy in orthogonal planes, and the appearance of normal structures on different pulse sequences.
- Experience in supervision including vetting requests, determining protocols, the examination, and post processing and reporting of the examination in the following anatomical sites:
  - Brain - head and neck
  - Chest –abdomen and pelvis- musculoskeletal (e.g. hips, knees, shoulders and extremities)
- Experience of the application of MR angiography and venography
- Familiarity with post image acquisition processing NB: this experience may have been gained during a system-based attachment, or during a magnetic resonance attachment.

### **Ultrasound Imaging**

- Knowledge of the technical aspects of ultrasound relevant to optimizing image quality
- Knowledge of the cross-sectional anatomy as visualized on ultrasound
- Experience in performing and reporting transabdominal ultrasound examination of structures in the following anatomical areas:
  - General abdomen (including vessels)
  - Obstetric - pelvis (non-obstetric) - small parts (scrotum, thyroid, neck structures)
  - Upper abdomen (including lower chest)
- Experience of performing Doppler ultrasound imaging (e.g. leg veins, portal vein, carotid artery)
- Performing ultrasound of the breast
- Performing transcranial pediatric ultrasound
- Experience in ultrasound of the musculoskeletal system, optional.
- Knowledge of ultrasound-guided interventional procedures (e.g. biopsy and drainage)
  - Knowledge of obstetric ultrasound.



## **Interventional Radiology**

- Familiarity with the equipment and techniques used in vascular, biliary and renal interventional techniques
- Familiarity with the indications, contraindications, pre-procedure preparation including informed consent, patient monitoring during the procedure and post procedure patient care
- Ultrasound-guided interventional procedures (e.g. biopsy and drainage) Optional
- Observation of the spectrum of interventional procedures currently performed in the following systems, optional:
  - Observation and knowledge of Vascular system (including neurovascular)
  - Urinary system
  - Biliary system
  - Gastrointestinal system
  - Musculoskeletal system

## **General Professional Development**

The Trainee will continue to develop expertise in relation to current clinical practice as it relates to radiology, applied pathology, physiology and molecular biology as they relate to the practice of radiology and statistical and research methods.

The trainee will also continue to develop a high level of expertise in teaching, clinical audit and departmental management. This will include clinical governance and risk management, and issues relating to human resources within the Radiology Department.

The trainee will also maintain a high level of continuing general professional development.

The trainee will maintain a high level of expertise in terms of basic Life Support (BLS) in which they must be regularly certified according to local practice. It is advised that experts in these areas will give training in these areas, either by inviting speakers in to the courses or alternatively attending externally organized seminars in these areas.

## **Other Modules**

The trainee will be given instruction in Communication Skills, which are a key part of the essential attributes of a well-trained radiologist.

Trainees will also be given modular training in report writing.

**The department will carry out Assessments Summative / Continuous Annual trainee summative assessments/**

Council centrally on a formal basis as well as more frequent and less formal local formative appraisals as specified in relation to the first training year as outlined. These assessments are in addition to ongoing workplace based assessments on a daily basis.

The aim of the appraisal is to verify the trainees experience and competence gained during the preceding year and to review progress and professional development.

Any deficiencies in expected knowledge identified. The assessment formalized by completing the assessment form between trainee and head of department.

**Subjects assessed include, the head of department to make sure that the trinee should have the basic knowledge of the followings:**

Radiological Skills

- Syllabus Content Knowledge
- Basic Science
- Clinical
- Health Outcomes
- Management Postgraduate Activities
- Teaching
- Audit
- Research (Posters and Presentations), at least one published research.
- Presentation Skills Personal Qualities
- Communication
- Time Management
- Reliability
- Self-Motivation
- Leadership
- Self-Awareness Observed Professional Relationships
- Senior Colleagues
- Junior Colleagues

**Future Developments** Trainees are expected to develop a high level of expertise in information technology, as it applies to word processing, digital dictation techniques (including voice recognition) database creation and maintenance, lecture and other research presentation, email and internet. They should also be aware of information technology systems used for patient record keeping and transfer of clinical data and strive for best practice in use and maintenance of these systems, complying with legislation regarding patient confidentiality and freedom of information.

**Final Statement** By the end of the formal four year training process, the trainee should have a broad experience of interpreting and reporting radiographs in all specialist areas. They should have acquired the expertise needed to perform and report the core procedures outlined above. It is intended that the radiologist be a key player in clinical decision making and have developed communication skills to copper fasten this role in relation to consultation with clinical colleagues and most importantly with patients. It is intended that the trained radiologist be a rounded individual with a high level of integrity, who maintains an active interest in research, teaching and clinical audit as dictated above and keeps abreast of new developments in information technology and clinical radiology.

## **Curriculum Review Recommendations**

### **1 Further Definitive Review**

– Every 5 years Include Review of Core & Optional Knowledge & Skills with input from Radiologists with relevant subspecialty or specialist interest ‘Learning Objectives’ consider adding at each organ specific topic

- Appraisal Consider adding more detail as the formative methods are developed

- Assessment Consider adding detail on numbers required of direct observation

Annual Update To ensure no substantial changes required prior to a new academic year Appendices Appraisal / Evaluation Forms.

Comments:

### **1. LOG BOOK & ATTENDANCE report.**

**Form 2**

**Radiology Rotations, *to be filled and presented to the head of the department.***

**Name of trainee:**

**Hospital:**

**Date of start of training:**

**Name of radiology supervisor:**

**Head of department:**

	<b>Date of rotation</b>	<b>Deficient Score 1-4</b>	<b>Borderline Score 5</b>	<b>Satisfactory Score 6</b>	<b>Excellent Score 7-8</b>	<b>Score</b>
<b>Plain films</b>						
<b>Contrast procedures</b>						
<b>Ultrasound</b>						
<b>CT scan</b>						
<b>MRI</b>						
<b>Angio/interventional</b>						
<b>Mammography</b>						
<b>Communication</b>						
<b>Attendance</b>						
<b>Total score</b>						

**Decision of the HOD:**

**Signature of HOD:**

## Form 3

**Trainee Evaluation Form, *to be filled and presented to the head of the department.***

<b>Trainee:</b> <b>ROTATION/ATTACHMENT:</b> <b>DATES OF ROTATION:</b> <b>YEAR OF TRAINING:</b> <b>CONSULTANT TRAINER:</b>	<b>SCORE</b> <b>0 - not done or too small component of rotation/attachment to be rated</b> <b>1 – 5 Deficient</b> <b>6 - satisfactory</b> <b>7-8 good</b>
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### 1- Radiological skills

	Deficient Score 0-5	Satisfactory Score 6	Good Score 7-8	Score
Plain films	Poor observation Poor conclusions	Usually accurate	Precise	
Contrast	Poor technique Poor images	Competent	Good	
Ultrasound	Poor techniques Frequent errors	Competent	Good	
CT	Difficult with technique No distinction between normal and abnormal	Reasonable analysis and conclusion	Reliable and accurate	
MRI	Difficult with technique No distinction between normal and abnormal	Reasonable analysis and conclusion	Reliable and accurate	
Mammography	Poor observation Poor conclusion	Usually accurate	Usually accurate and perceptive	

## 2. KNOWLEDGE

	Deficient	Satisfactory	Excellent	Score
Basic	Uninterested	Adequate	Outstanding	
Clinical	Poor	Satisfactory	Outstanding	
Health outcomes	No knowledge	Satisfactory	Good appreciation	
Management	Uninterested	Basic	Good appreciation	

## 3. Post graduate Activities

	Deficient	Satisfactory	Excellent	Score
Teaching	Uninterested	Competent	Excellent	
Audit	No idea	Tried hard	Ideas put in practice	
Research	No idea	Makes an effort	Publications done or in progress	
Presentations	Inadequate	Poor preparation	Clear presentation and conclusions	

**11- PERSONAL QUALITIES**

	Deficient	Satisfactory	Excellent	Score
Communications with colleagues	No communication	Effective	Conscious	
Time management	Unreliable	Can deal	Confident	
Reliability	Unreliable	Dependable	Highly conscious	
Self-motivation	Lack	Hard working	Enthusiastic	
Leadership	Limited	Competent	Outstanding	
Self-awareness	Not aware	Self-aware	Alert	

**12- Observed professional relationships**

	Deficient	Satisfactory	Excellent	Score
With seniors	Bad	Good	Excellent	
With Juniors	Bad	Good	Excellent	
With technicians	Bad	Good	Excellent	
With patients	Bad	Good	Excellent	

**Decision of the HOD:****Signature of HOD:**

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- Grainger & Allison's Diagnostic Radiology, 6th Edition .Andy Adam, Adrian K Dixon, Jonathan H Gillard & Cornelia Schaefer-Prokop, Eds. Elsevier Health Sciences, 2014
- Fundamentals of Diagnostic Radiology. 4th Edition. William E Brant & Clyde Helms, Eds. Wolters Kluwer-Lippincott Williams & Wilkins, 2012
- MRI in Practice. 4th Edition. Catherine Westbrook, Carolyn Kaut Roth & John Talbot. Wiley-Blackwell, 2011
- Radiology Review Manual. 7th Edition. Wolfgang Dahnert. Wolters KluwerLippincott Williams & Wilkins, 2011

### SUGGESTED further readings IN RADIOLOGY

#### Web Sites to Search:

[WWW.AUNTMINNIE.COM](http://WWW.AUNTMINNIE.COM)

WWW.RSNA.ORG WWW.RADIOLOGY.RSNAJNLS.ORG

[WWW.RADIOGRAPHIC.RSNAJNLS.ORG](http://WWW.RADIOGRAPHIC.RSNAJNLS.ORG)

WWW.MYSTATDX.COM WWW.ACR.ORG

### Recommended other Readings:

- **Fundamentals of Skeletal Radiology**, 4th Edition. Clyde A Helms. Elsever Saunders, 2013
- **Orthopedic Imaging**, A practical approach, 6th Edition. Adam Greenspan & Javier Beltran. Wolters Kluwer, 2014
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- **MRI in Orthopedic & Sports Medicine**. 3rd Edition. David S Stoller Ed.. Wolters Kluwer- Lippincott Williams & Wilkins. 2007
- **Arthritis in Black and White**, 3rd Edition. Ann C Brower Donald Fleming. Elsevier, 2012
- **Imaging of Arthritis and Metabolic Bone Disease**. Barbara Weissman. Elsevier Health Sciences, 2009
- **Metabolic Bone Disease**. Rosenthal, D.I., In: The Radiologic Clinics of North America, volume 29, No.I, January 1991.
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- **A-Z of Musculoskeletal and Trauma Radiology**. James R D Murray, Erskine J Holmes & Rakesh R Misra. Cambridge University Press, 2008
- **Radiology of Skeletal Trauma**, 3rd Edition. Lee F Rogers. Elsevier Health Sciences, 2001



- **MRI of the Musculoskeletal System.** 6th Edition. Thomas H Berquist. Wolters KulwerLippincott Williams & Wilkins, 2012
- **Musculoskeletal Imaging: Case Review Series.** 2nd Edition. Joseph Yu & Joseph S Yu. Mosby Elsevier, 2008.
- **Spinal Trauma- An Imaging Approach.** Victor N Cassar-Pullicino& Herwig Imhof. Thieme, 2006
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- **Neuroradiology , The requisites.** 3rd Edition. David M Youssef& Robert D Zimmerman. Mosby Elsevier, 2010
- **Ultrasonography in Obstetrics & Gynecology,** 5th Edition. P W Callen, Ed. W.B. Saunders, 2007
- **A Practical Guide to Ultrasound in Obstetrics and Gynecology.**2nd Edition. Eric E Sauerbrei, Khanh Nguyen, & R L Nolan. Lippincott - Raven, 1997.
- **Diagnostic Imaging of Fetal Anomalies.** David A Nyberg, John P McGahan, Dolores H Pretorius & Gianluigi Pilu. Lippincott Williams & Wilkins, 2002
- **Prenatal Diagnosis of Congenital Anomalies.** Roberto Romero. Appleton & Lange, 2000
- **Diagnostic Imaging: Obstetrics.**2nd Edition. Paula J Woodward, Anne Kennedy, Roy Sohaey. Amirsys, 2011
- **Diagnostic Imaging: Gynecology.**2nd Edition. Akram M Shaaban, Ed. Amirsys, 2014
- **Genitourinary Radiology : The requisites.** 3rd Edition. Ronald J Zagoria, Christopher M Brady & Raymond B Dyer. Elsevier, 2015
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