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Chapter 1

INTRODUCTION

These are challenging as well as uncertain times for the Radiology fraternity. Challenging, since radiology is at the forefront of medical progress. From its infancy with X-rays to the present moment with MR spectroscopy and interventional procedures there seems to be no end of progress. When you think there can be no further progress along comes some new technological advance, which propels it even further ahead. Often, the technological advances seem to precede the clinical applications, a situation akin to a product looking for a purpose. Uncertainty is brought about by the changes occurring in the health care system and the introduction of corporate and privatised public facilities. We also now face an increasing trend of other clinicians specialising in imaging as boundaries in Medicine become blurred and ill-defined.

You have made a decision to become a radiologist by joining this programme. This is the first step on the lifelong commitment to continuous education and learning. The Master of Radiology program provides you the broad guidelines to assist you in this process but we expect you to be in the driver's seat and contribute a large part of the learning, i.e. self-directed learning. Also do not forget that this is a 4-year programme and that you need to pace yourself to succeed. Do not leave things to the last minute since it will most certainly fail since there is just too much to know and understand.

Another issue that you must grasp is the need for co-operation where you must learn to work with your colleagues as a group since this will make life so much easier. The time for "unhealthy" competition is over. You should feel that any failure in the group is a failure of the whole group.

The Master of Radiology in the University of Malaya was started in 1992. It is a structured program with definite course requirements, which must be fulfilled before the candidate is conferred a degree. This course is fully recognised by the Ministry of Health Malaysia as well as the Royal College of Radiologists, London for training requirements though no exemptions are given. The Ministry awards scholarships or paid leave to do the course.

From June 1997 in partnership with the Conjoint Committee, the University of Malaya has started running the examinations jointly with Universiti Sains Malaysia and Universiti Kebangsaan Malaysia using the same examination papers and questions. The viva examinations are held in UM, USM & UKM in alternate years.

In 2008, the Master of Radiology External program commenced with selected candidates placed full time in hospitals within the Ministry of Health.

We welcome you to this master's program and hope that the years you spend here are fruitful and memorable.

Chapter 2

PHILOSOPHY & OUTLINE OF THE TRAINING PROGRAMME

The trainees entering this program are required to have a minimum of two years' clinical experience following graduation in a clinical discipline. This should consist of a one-year housemanship and another year of medical officer training. The Ministry of Health may, however, impose additional requirements above and beyond these for their officers before they may be allowed to join the programme.

At the end of the 4 years of training it is expected that the trainee emerges as a well-trained and competent general radiologist with or without areas of special interest. We are training a doctor who is able to function competently in a clinical environment as part of the team managing the patient together with other specialists.. Even though this is a structured programme with didactic lectures and tutorials, a major component is the clinical training which is based on the system of apprenticeship where the trainee will be involved performed increasingly complex radiological procedures in patient's radiological diagnosis and management services as well as a radiologist requires a solid background in clinical medicine to enhance the working relationship with the clinicians in other disciplines. A radiologist must be conversant with the basic clinical sciences relevant to diagnostic imaging, the pathological and functional aspects of disease, the current management of diseases and the role of radiology in management. This is essential to be able to correlate the history, clinical and biochemical findings as well as the radiological findings to provide the best care possible. What it means is that we are actually **CLINICAL RADIOLOGISTS**. There should also be competence in the administrative practice and medico-legal aspects of radiological practice. The elements of research methodology and conduct should be present at completion.

The training programme is to achieve competency in all aspects of radiology, which will enable you to practise as an independent, responsible and safe specialist. The 4-year training programme will have a different emphasis for each year.

- Year I emphasises the basic sciences (including basic trauma radiography)
Stage 1
- Years 2 and 3 emphasise the basic radiological signs, ability to discuss the diagnosis and differential diagnoses. Trainee is also expected to design a research project and begin data collection by this stage. Stage 2
- Year 4 emphasises on the role of imaging in the overall management of the patient
The research project is to be completed. Stage 3

These are broad guidelines but it is expected that all 3 aspects are occurring simultaneously in varying degrees with experience and exposure.

Chapter 3

FIRST YEAR

For most trainees the first year represents their first opportunity to learn the radiological skills since some of you would not have had the luxury of working in a radiology department. This is not necessarily bad since you will not have any preconceived ideas about radiology practices.

It is expected that at the end of the first year the trainees should;

- Feel confident in his/her choice of clinical radiology as a career.
- Have mastered and understood the basic sciences of clinical radiology (physics, radiological anatomy radiological techniques and basic trauma).
- Be familiar with the concepts and terminology of diagnostic and interventional techniques in all age groups.
- Understand the role and usefulness of the various diagnostic and interventional techniques in different clinical scenarios in all age groups.
- Have learnt and performed core radiological and radiographic procedures.
- Aware of the risk and complications of these procedures as well as the managements of these complications.
- Understand the responsibilities of a radiologist to the patient and the need for informed consent.
- Be familiar with the various contrast media and drugs (including intravenous sedation) and monitoring used by clinical radiologists in day-to-day practice, and be aware of indications, contraindications, doses (adult and paediatric) and the management of reactions and complications.
- Be fully competent in cardio-pulmonary resuscitation.
- Understand the principles of radiation protection and be familiar with the legal framework for protection against ionising radiation. The trainee should also demonstrate that he/she is capable of safe radiological practice.
- Be familiar with safety requirements for imaging with ultrasound and magnetic resonance.
- Have developed, under supervision, basic reporting skills.

How do you go about achieving all these?

3.1 Tutorials & discussions

Tutorials are in the form of seminar type (assignment and discussion). Such regular seminars will be conducted in which the candidates are to participate actively and fully.

Role of Candidates: The trainees are given topics in advance to prepare and to present. The candidates are advised to use power point presentations. There are also lap-tops which may be used for presentation. The trainees are advised to do a good job since it would make things easier for everyone if all the relevant information has been provided. Any uncertainties should be referred to the lecturer assigned for that particular session. If you could prepare notes for your colleagues that would also be helpful.

It is suggested that these presentations be in the **MODULAR FORM** and should cover the following aspects:

- Basic anatomy, radiological anatomy and normal variants and radiography.
- Enumerate all radiological investigations pertaining to that organ.
- Discuss the technique (procedure) of every radiological investigation – radiographs or appropriate images to be shown.
- Types of contrast media used and why; complications and management.
- Complications of the procedure itself and management.
- Advice to clinicians.

Role of lecturers: The lecturers who are assigned to conduct these tutorials/seminar /assignment are there to provide guidance and to correct or add relevant information during the discussion. They are not there to give all the information. Lecturers may, however, pose questions during the lecture to ascertain student understands.

3.2 Basic Sciences

An introductory course on basic sciences relevant to clinical radiology is held during the first year. The lectures and tutorials will be jointly held with Universiti Kebangsaan Malaysia. The core knowledge is required to pass the Part I examination. Even though there will be supervision the trainees will be required to supplement this with substantial self-learning.

3.2.1. Physics

This consists of lectures and practical sessions. Primarily the medical physicist will give this teaching. During formal teaching, all physics demonstrations/practical will have a direct relevance to everyday radiology.

A basic knowledge of physics is assumed. Basic electricity, magnetism and mathematics are not included in the syllabus and questions on these subjects will not be included in the examination.

Equipment design and construction details will **not** be examined, but an understanding of the **function** of equipment components relevant to image formation may be tested.

A mathematical approach to the physics syllabus is not required; the emphasis will be placed on a clear understanding of the physical basis of radiological practice in a qualitative sense. However, the knowledge of the approximate magnitude of quantities encountered in daily practice will be expected, e.g. percentage transmission of X-radiation through a patient; the activity of a radionuclide used for bone scanning.

Knowledge of the principles of quality assurance, contrast resolution, spatial resolution and noise is expected for all the sections covered.

The trainees should have knowledge of radiation protection sufficient to:

- (a) Understand current official radiation protection guidelines and regulation and to be able to explain those guidelines and regulations to medical and radiographic staff as well as to patients, both for clinical practice and research purposes.
- (b) Comprehend those practical measures, which should be in place in department of Clinical Radiology.
- (c) Understand the relative risks of medical radiation.

The trainees are also required to have sufficient knowledge of X-radiation and diagnostic X-ray equipment to be able to understand the interaction of X-rays on tissues and the factors that affect image quality, in order to be able to discuss these subjects with radiographers and clinicians, to recognise artefacts and to be able to use equipment correctly.

A sufficient knowledge of the basic principles of ultrasound, CT, MRI and radionuclide imaging to be able to understand the nature of the radiation/sound waves used in these techniques is necessary. The trainees must understand, in outline, the performance of imaging equipment as well as the means by which the relevant images are created.

3.2.2 Radiological Anatomy

Trainees are reminded on the importance of anatomy as seen on the different imaging modalities and not only the gross anatomy. CT, MRI and Ultrasound anatomy are essential. As mentioned previously, the lecturers will supervise this teaching but the trainees themselves will conduct the tutorials.

The trainees should use the opportunity of the reporting sessions to enhance their appreciation of radiological anatomy. The CT as well as the MRI and ultrasound posting should be used to get a good appreciation of sectional anatomy as this is being increasingly required in practice and for the examinations. This information unfortunately has to be obtained from a variety of sources.

3.2.3 Radiological and Radiographic Techniques

In the first year of training the trainees must begin to acquire some of the practical skills that will eventually be required of a consultant radiologist. Formal tuition on radiological and radiographic techniques will also be given. Clinical radiologists and radiographers will supervise this teaching. The use of contrast media for x-ray based imaging and MRI must be covered thoroughly. The types of reaction as well as the prevention and management of these are also of paramount importance.

Radiography: With the guidance and help of Radiographers/Tutors/Lecturers, trainees are required to perform 20 radiographs comprising all the systems. These must be recorded in a logbook, which must be submitted to the department as a requirement for sitting for the Part I examinations.

Important guidelines to be recorded in the log book as follows:

- (i) Position of patient and state of respiration.
- (ii) Film locations.
- (iii) Orientation of planes and radiographic lines.
- (iv) Position and angulations of x-ray tube.
- (v) Type of film and film screen combination.
- (vi) Focus film distance.
- (vii) Exposure factors: KVp, mAs, MA.
- (viii) Centering point.
- (ix) Radiation protection.

3.2.4 Trauma

This will include plain radiographic interpretation of extremity injuries during the first stage of training.

3.3 Clinical Skill - Radiological and Radiographic techniques and procedures

The trainees under the radiologist's supervision should have performed the techniques and procedures listed as core. As regards the optional category given, the trainees should observe as

many of these as possible and become familiar with the technique even if they do not perform the procedure personally.

3.3.1 Vascular

Core

- ☐ Lower Limb Venography And / Or Ultrasound.
- ☐ Percutaneous arterial and venous diagnostic and interventional procedures

Optional

- ☐ Non-invasive vascular imaging including doppler ultrasound and magnetic resonance angiography
- ☐ Radionuclide imaging.

3.3.2. Cardiac

Core

- ☐ Plain Radiography

Optional

- ☐ Echocardiography
- ☐ Computed Tomography
- ☐ Magnetic Resonance Imaging
- ☐ Angiography
- ☐ Interventional Procedures

3.3.3 Chest

Core

- ☐ Plain Radiography
- ☐ Radionuclide Imaging
- ☐ Conventional And High-Resolution Computed Tomography

Optional

- ☐ Ultrasound
- ☐ Magnetic Resonance Imaging
- ☐ Angiography
- ☐ Interventional Procedures

3.3.4 E.N.T.

Core

- ☐ Computed Tomography
- ☐ Plain Radiography
- ☐ Sialography

Optional

- ☐ Magnetic Resonance Imaging
- ☐ Angiography

3.3.5 Breast

Core

- ☐ Mammography

Optional

- ☐ Ultrasound
- ☐ Interventional Procedure (E.G. Biopsy, Cyst Drainage)

3.3.6 Musculoskeletal

Core

- ☐ Plain Radiography
- ☐ Radionuclide Imaging
- ☐ Ultrasound
- ☐ Computed Tomography
- ☐ Magnetic Resonance Imaging
- ☐ Angiography

3.3.7 Gastrointestinal

Core

- ☐ Plain radiography
- ☐ Contrast swallow
- ☐ Contrast meal
- ☐ Contrast small bowel examination
- ☐ Contrast enema
- ☐ Transabdominal ultrasound
- ☐ Sinogram
- ☐ Post-operative T-tube cholangiogram
- ☐ Computed tomography
- ☐ Angiography

- ☐ ERCP
- ☐ Percutaneous transhepatic cholangiogram (PTC) / biliary drainage
- ☐ Interventional procedures
- ☐ Intra-operative cholangiogram
- ☐ Radionuclide imaging

Optional

- ☐ Magnetic resonance imaging

3.3.8 Uroradiology

Core

Plain Radiography

Intravenous Urogram

Transabdominal Ultrasound

- ☐ Nephrostogram
- ☐ Radionuclide imaging
- ☐ Computed tomography
- ☐ Antegrade / retrograde pyelogram
- ☐ Nephrostomy
- ☐ Angiography

Optional

- ☐ Endoluminal ultrasound
- ☐ Magnetic resonance imaging

3.3.9 Reproductive System

Core

- ☐ Hysterosalpingogram
- ☐ Scrotal ultrasound
- ☐ Transabdominal ultrasound (including Obstetric)

Optional

- ☐ Computed tomography
- ☐ Magnetic resonance imaging

3.3.10 Neuroradiology

Core

- ☐ Plain radiography
- ☐ Computed tomography (Brain)
- ☐ Computed tomography of Spine
- ☐ Radionuclide imaging
- ☐ Ultrasound including Doppler
- ☐ Myelography
- ☐ CT Myelography
- ☐ Angiography (conventional, CT angiography and magnetic resonance angiography)
- ☐ Magnetic resonance imaging (brain and spine)

Optional

3.3.11 Paediatric

Core

- ☐ Plain radiography
- ☐ Transabdominal ultrasound
- ☐ Routine contrast examination of the gastrointestinal system
- ☐ Routine contrast examination of the urinary tract
- ☐ Ultrasound of the neonatal head

Optional

- ☐ Radionuclide imaging
- ☐ Computed tomography and magnetic resonance imaging with special reference to technique, sedation and anaesthesia

3.4 Clinical Skills - Interpretative/Communication and Report Writing

In the first year of training the trainees must begin to acquire some of the interpretative, reporting and communication skills that will eventually be required of a consultant radiologist.

For the core, the trainees will have interpreted and formally report the following under the supervision of a recognised trainer.

Core

- ❑ All core procedures and techniques performed by the trainees.
- ❑ Radiographs from the A/E.
- ❑ Selection of urgent in-patient and out-patient radiographs.
- ❑ The reporting of ultrasound, nuclear medicine, computed tomography and magnetic resonance investigations
- ❑ The reporting of paediatric investigations

Optional

- ❑ The reporting of special procedures not performed by the trainees.

3.5 Assessments

Each trainee has an appointed academic advisor/supervisor who should be consulted for advice on problems that they may encounter. A three monthly meeting is advised.

3.5.1. The Department usually conducts a mock examination normally sometime in January/February of the next year. Even though you may not have covered some of the topics it is conducted to give the candidate a feel of the examinations plus a couple of months to correct any small mistake. So do not despair with the outcome.

3.5.2. The University also tries to bring in a Medical Physicist from England to help with the Part I, when finance permits.

3.6 The Part I examination

This will consist of 4 components:

- MCQ paper
- Viva voce
- OSCE (Objective Short Clinical Examination)
- OSPE (Objective Structured Practical Examination)

To pass the examination, the candidate is required to obtain 50% or more in each component of the examination. A candidate who does not fulfil the above requirement for a component shall be deemed to have failed the component concerned but will be credited with the components that he or she has passed and be required to repeat the component that he or she has failed. A candidate who has failed will be permitted a re-examination on 2 separate occasions at 6 monthly intervals.

Students can only proceed to Year II after passing Part one. The research project will only begin upon passing the Part I as well.

Chapter 4

THE SECOND AND THIRD YEARS

During the second and third years trainees will continue to receive training in all aspects of specialities of Clinical Radiology and Medical Physics. The training over these two years even though separated by calendar years should be considered as being one. It is suggested that the 2nd year be used to recognize the basic radiological signs along with pathological basis for them. The 2nd year should also be used to pick – up the basic radiological knowledge. In year 2, the trainees should see the relevancy of Medical Physics in radiology and a more comprehensive knowledge of computed tomography, diagnostic ultrasound, MRI, radionuclide imaging, digital imaging and interventional procedures.

The 3rd year should then be used to build up on these and allow a discussion of the possible disease processes as well as some of the management issues. At the end of the third year, a trainee will sit for the Part II examination again conjointly conducted with UKM/USM.

The trainee will be required to start work on the major project according to the schedule provided in the manual for project proposal and write-up. This aspect is covered in a different section on Writing the Research Proposal.

The Objective at the end of the third year is that the trainee should;

- Be expected to be able to detect and describe the radiological features of pathology as seen on the different imaging modalities.
- Followed by a radiological-pathological correlation as to the underlying disease.
- The trainees should be able to discuss the differential diagnoses in view of the clinical presentation.
- Have substantial experience of interpreting and reporting plain radiographs in all subspecialties.
- Have acquired experience of performing and reporting all core procedures as defined in sections 4.2.3 to 4.2.22.
- Be able to advise clinicians on appropriate imaging algorithms for the investigation of standard clinical situations e.g. jaundice.
- Be able to perform and give a provisional interpretation of standard emergency imaging procedures, e.g. CT brain scan, transabdominal ultrasound, transfemoral aortography, intravenous urogram and contrast examinations of the gastrointestinal tract.
- Be capable of conducting radiological –clinical conferences under supervision.
- Understand the role of a radiologist in management of radiological equipment.

4.1 Overview

The system based specialties e.g.:

- ☐ Vascular
- ☐ Chest
- ☐ Musculoskeletal
- ☐ Gastrointestinal
- ☐ Uroradiology
- ☐ Neuroradiology

will be incorporated in an integrated fashion.

There will, however, be an opportunity to have technique based speciality training e.g:

- ☐ Ultrasound
- ☐ MRI
- ☐ Intervention
- ☐ CT
- ☐ Nuclear imaging & Pet Scan
- ☐ Mamm

Disease based specialties

- ☐ Oncology
- ☐ Trauma
- ☐ Breast

Age based specialties

- ☐ Paediatric
- ☐ Geriatric

4.2 Clinical Skills

4.2.1 The following sections delineate the core knowledge that will be acquired during the second and third year rotations. Where an optional category is given, practical experience is not essential but a theoretical knowledge is still required.

4.2.2 General Radiology

Core

- ☐ Have a secure knowledge of the current legislation regarding radiation protection.
- ☐ Participation in reporting plain radiographs which are taken during the general throughput of the normal working day of a clinical radiology department

- ❑ Performing any routine radiological procedures that might be booked during a normal working day.

4.2.3 **Vascular**

A) Arterial

Core

- ❑ Consolidation of knowledge of vascular anatomy and clinical practice relevant to clinical radiology.
- ❑ Reporting plain radiographs relevant to cardiovascular disease.
- ❑ Familiarity with the indications, contraindications, pre-procedure preparation (including informed consent), patient monitoring during procedures and post-procedure patient care.
- ❑ Familiarity with procedure and post-procedure complications and their management.
- ❑ Obtaining practical experience of Seldinger femoral artery puncture technique, and the introduction of guide wires And catheters into the arterial system.
- ❑ Performing and reporting the following procedures:
 - Lower Limb Angiogram
 - Arch Aortogram
 - Abdominal Aortogram
 - Selective Angiogram (e.g. Hepatic, Renal, Visceral)
- ❑ CT angiography

Optional

- ❑ Alternative Arterial Access (e.g. Brachial, Axillary Puncture)

B) Venous

Core

- ❑ Performing and reporting lower limb venography (contrast or ultrasound).

Optional

- ❑ Portal Venogram
- ❑ Upper Limb Venogram
- ❑ Superior Vena Cavogram
- ❑ Inferior Vena Cavogram

C) Interventional

Core

- ❑ Familiarity with the indications, contraindications, pre-procedure preparation

(including informed consent), patient monitoring during the procedure and post-procedure patient care.

- ☐ Familiarity with procedure and post-procedure complications and their management.
- ☐ Obtaining practical experience of the introduction systems, guide wires and catheters required.
- ☐ Assisting in the performance of the following procedures:
 - Femoral Angioplasty
 - Iliac Angioplasty
 - Insertion of central line image guided biopsies
 - Nephrostomy
 - Drainage of collection

Optional

- ☐ Renal Angioplasty
- ☐ Embolisation
- ☐ Thrombolysis
- ☐ Stenting

D) Other Vascular Imaging Techniques

Core

- ☐ Familiarity with the appropriate applications of the following techniques:
 - Ultrasound (including Doppler)
 - Computed Tomography and CT Angiography
 - Magnetic Resonance Imaging and Magnetic Resonance Angiography.

4.2.4 Cardiac

Core

- ☐ Knowledge of cardiac anatomy and clinical practice relevant to Clinical Radiology.
- ☐ Reporting plain radiographs performed to show cardiac disease.
- ☐ Observe the technique of echocardiography.
- ☐ Familiarity with the application of the following techniques:
 - Echocardiography (including Transoesophageal)
 - Nuclear Medicine
 - Computed Tomography
 - Magnetic Resonance Imaging
 - Angiography

Optional

- ☐ Observing Coronary Angiography and other cardiac angiographic procedures.
- ☐ Obtaining practical experience in Echocardiography.

4.2.5 Chest

Core

- ☐ Knowledge of respiratory anatomy and clinical practice relevant to clinical radiology.
- ☐ Reporting plain radiographs performed to show chest disease.
- ☐ Obtaining experience in the application of nuclear Medicine to imaging chest pathology with particular experience of reporting radionuclide lung scans.
- ☐ Obtaining experience in performing and reporting computed tomography scans of the chest, including high resolution scans.
- ☐ Observing the technique of image guided biopsy of chest lesions.

Optional

- ☐ Empyema drainage

4.2.6 ENT

Core

- ☐ Knowledge of ENT anatomy and clinical practice relevant to clinical radiology.
- ☐ Reporting plain radiographs performed to show ENT disease.
- ☐ Obtaining practical experience of relevant contrast examinations (e.g. barium studies, sialography).
- ☐ Obtaining experience of performing and reporting computed tomography scans.
- ☐ Obtaining experience of performing and reporting magnetic resonance scans.
- ☐ An awareness of the proper application of other imaging techniques to this specialty (e.g. ultrasound, nuclear medicine, angiography).

Optional

- ☐ Video swallows

4.2.7 Breast

Core

- ☐ Understanding the principles of current practice in breast imaging and breast cancer screening.

- ☐ Knowledge of breast pathology and clinical practice relevant to clinical radiology.
- ☐ Observing mammographic reporting sessions (screening and symptomatic).
- ☐ Awareness of the proper application of other imaging techniques to this specialty
(e.g. ultrasound, magnetic resonance techniques).
- ☐ Knowledge of the role and image guided biopsies in the management of breast disease.

4.2.8 Musculoskeletal

Core

- ☐ Knowledge of musculoskeletal anatomy and current clinical practice relevant to clinical radiology.
- ☐ Reporting plain radiographs relevant to the diagnosis of disorders of the musculoskeletal system.
- ☐ Obtaining practical experience of the relevant contrast examinations (e.g. arthrography)
- ☐ Obtaining experience in reporting radionuclide scans of the musculoskeletal system, particularly bones scans.
- ☐ Obtaining experience in performing and reporting computed tomography scans of the musculoskeletal system.
- ☐ Obtaining experience in performing and reporting magnetic resonance scans of the musculoskeletal system.
- ☐ Obtaining experience in performing and reporting ultrasound scans of the musculoskeletal system.
- ☐ Obtaining experience in bone densitometry

Optional

- ☐ Observing discography and injections
- ☐ Observing techniques for image guided bone biopsy

4.2.9 Gastrointestinal (Including Liver, Pancreas And Spleen)

Core

- ☐ Knowledge of gastrointestinal anatomy and clinical practice relevant to clinical radiology.
- ☐ Reporting plain radiographs performed to show gastrointestinal disease.
- ☐ Obtaining practical experience of the following:
Barium Swallow And Meal

Small Bowel Barium Studies

Barium Enema

- ❑ Obtaining practical experience in the following contrast medium studies:

Cholangiography (T-Tube, Percutaneous)

Sinogram

Stomagram

- ❑ Obtaining practical experience in the application of transabdominal ultrasound imaging to the gastrointestinal system.
- ❑ Familiarity with the current application of nuclear medicine to the gastrointestinal tract in the following areas:

Liver

Biliary System

Gastrointestinal Bleeding (Including Meckel's Diverticulum)

Abscess Location

Assessment Of Inflammatory Bowel Disease

- ❑ Obtaining experience of performing and reporting computed tomography scans of the gastrointestinal system.
- ❑ Awareness of the application of angiography and vascular interventional techniques to this subspecialty.
- ❑ Familiarity with the relevant application of the following interventional procedures:

Percutaneous Biliary Stenting

Ultrasound Guided Biopsy And Drainage

Computed Tomography Guided Biopsy And Drainage

Balloon Dilatation Of The Oesophagus / Stent Insertion

- ❑ Observe ERCP and other diagnostic and therapeutic endoscopic techniques.

Optional

- ❑ Magnetic resonance imaging applied to the gastrointestinal system
- ❑ GI video studies.
- ❑ CT colonography

4.2.10 Uroradiology

Core

- ❑ Knowledge of urinary tract anatomy and clinical practice relevant to clinical radiology.

- ❑ Reporting plain radiographs performed to show urinary tract disease.
- ❑ Obtaining experience of performing and reporting the following contrast medium studies.

Intravenous Urogram
Retrograde Pyelo-Ureterography
Loopogram
Nephrostogram
Ascending Urethrogram
Micturating Cysto-Urethrogram

- ❑ Awareness of the application of angiography and vascular interventional techniques.
- ❑ Obtaining practical experience in percutaneous renal puncture as a prelude to performing nephrostomy.
- ❑ Familiarity with the current application of nuclear medicine to urinary tract imaging in the following areas:
 - Kidney
 - Renal Function
 - Vesico-Ureteric Reflux
- ❑ Obtaining practical experience in the application of transabdominal ultrasound to imaging the urinary tract.
- ❑ Obtaining experience in performing and reporting computed tomography scans of the urinary tract.

Optional

- ❑ Observing the following techniques:
 - Urodynamics
 - Percutaneous Ureteric Stent Placement
 - Percutaneous Nephrolithotomy
- ❑ Magnetic resonance imaging applied to the urinary tract.

4.2.11 Obstetrics And Gynaecology

Core

- ❑ Knowledge of obstetric and gynaecological anatomy and clinical practice relevant to clinical radiology.
- ❑ Reporting plain radiographs performed to show obstetric and gynaecological disorders.

Obtaining Practical Experience Of The Application Of Transabdominal And Endovaginal Ultrasound In:

Obstetrics

Gynaecology

- ❑ Obtaining experience in performing and reporting computed tomography scans in gynaecological disorders, and to be aware of all obstetric applications (e.g. assessing pelvic dimensions)
- ❑ Awareness of the applications of angiography and vascular interventional techniques.
- ❑ Hysterosalpingogram

Optional

- ❑ Magnetic resonance imaging applied to gynaecological disorders.

4.2.12 Neuroradiology

Core

- ❑ Knowledge of neuroanatomy and neurological clinical practice relevant to clinical radiology.
- ❑ Reporting plain radiographs performed in the investigation of neurological disorders.
- ❑ Obtaining experience in performing and reporting computed tomography brain scans.
- ❑ Obtaining experience in performing and reporting magnetic resonance scans of:

Brain

Spine

- ❑ Familiarity with the applications of nuclear medicine to neuro-imaging.
- ❑ Obtaining experience in performing and reporting myelogram procedures.
- ❑ Obtaining experience in performing and reporting cerebral angiograms.
- ❑ Familiarity with the applications of magnetic resonance angiography in imaging the cerebral vascular system.
- ❑ Observing transcranial and carotid ultrasound including doppler.

Optional

- ❑ Observing interventional neuroradiological procedures.

4.2.13 Ultrasound

Core

- ❑ Knowledge of the technical aspects of ultrasound relevant to optimising image quality.
- ❑ Knowledge of the relevant cross-sectional anatomy as visualised on ultrasound

- ❑ Knowledge of the basic principles of physics in ultrasound, including use of contrast media.
- ❑ Obtaining practical experience in performing transabdominal ultrasound examination of structures in the following anatomical areas:
 - Upper Abdomen (Including Lower Chest)
 - Pelvis (Non-Obstetric)
 - General Abdomen (Including Vessels)
 - Small Parts (Scrotum, Thyroid, Neck Structures)
 - Obstetric
- ❑ Familiarity with the practical applications of doppler ultrasound imaging (e.g. leg veins, portal vein, carotid artery)
- ❑ Obtaining practical experience in ultrasound guided interventional procedures (e.g. biopsy and drainage)
- ❑ Obtaining practical experience in echocardiography.
- ❑ Observing ultrasound of the breast
 - Optional
- ❑ Observing ultrasound of the musculoskeletal system

4.2.14 Nuclear Medicine

Core

- ❑ A secure knowledge of the relevant aspects of current legislation regarding the administration of radiopharmaceuticals.
- ❑ Knowledge of the technical aspects of nuclear medicine relevant to optimising image quality.
- ❑ Knowledge of radiopharmaceuticals currently available for the purpose of imaging organs and locating inflammatory collections, tumours and site of haemorrhages.
- ❑ Knowledge of the basic principles of physics in nuclear medicine.
- ❑ Experience of reporting radionuclide investigations in as many of the entities mentioned above as possible, but with particular experience in the following areas:
 - Bone
 - Lung
 - Kidney

4.2.15 Computed Tomography

This will be acquired during the CT posting

Core

- ❑ Knowledge of the technical aspects of performing a computed tomographic scan, including the use of contrast media.
- ❑ Knowledge of the relevant cross-sectional anatomy as visualised on computed tomography.
- ❑ Knowledge of the basic principles of physics in computed tomography.
- ❑ Practical experience in performing and reporting computed tomography in the following anatomical sites:
 - Brain
 - Head And Neck
 - Chest
 - Abdomen And Pelvis
 - Musculoskeletal
- ❑ Practical experience in performing computed tomography guided procedures (e.g. biopsy and drainage)

4.2.16 Magnetic Resonance

This will be acquired during the MRI posting

Core

- ❑ Understand current advice regarding the safety aspects of magnetic resonance imaging.
- ❑ Knowledge of the basic principles of physics in magnetic resonance imaging, including the use of contrast media.
- ❑ Knowledge of the relevant cross-sectional anatomy in orthogonal planes, and the appearance of normal structures on different pulse sequences.
- ❑ Experience in performing and reporting magnetic resonance scans in the following anatomical sites:
 - Brain / spine
 - Musculoskeletal

Optional

- ❑ Experience of magnetic resonance imaging in the following anatomical sites:
 - Head And Neck
 - Musculoskeletal System (E.G. Shoulder Joint, Extremities)
 - Cardiovascular System
 - Abdomen And Pelvis

4.2.17 Interventional

Core

- ❑ Familiarity with the equipment and techniques used in vascular, biliary and renal interventional techniques.
- ❑ Knowledge of the basic principles of physics in angiography.
- ❑ Familiarity with the indications, contraindication, pre-procedure preparation (including informed consent) patient monitoring during the procedure and post-procedure patient care
- ❑ Familiarity with procedure and post-procedure complications and their management
- ❑ Assisting in the performance of the following interventional procedures:
 - Femoral Angioplasty
 - Iliac Angioplasty
- ❑ Performing nephrostomies
- ❑ Obtaining practical experience of ultrasound guided interventional procedures (e.g. biopsy and drainage)
- ❑ Obtaining practical experience of computed tomography guided interventional procedures (e.g. biopsy and drainage)

Optional

- ❑ Observing the spectrum of interventional procedures currently performed in:
 - Vascular System (Including Neurovascular)
 - Urinary System
 - Biliary System
 - Gastrointestinal System
 - Musculoskeletal System

4.2.18 Oncology

Core

- ❑ Knowledge of clinical practice relevant to clinical radiology
- ❑ Familiarity with tumour staging nomenclature
- ❑ Reporting plain radiographs performed to assess tumours
- ❑ Obtaining practical experience in trans-abdominal ultrasound, nuclear medicine, computer tomography and magnetic resonance imaging and angiography, and interventional techniques in oncological staging, and monitoring the response of tumours therapy
- ❑ Familiarity with the radiological manifestations of complications which may occur in tumour management

4.2.19 Trauma

Core

- ☐ Knowledge of current clinical practice relevant to clinical radiology
- ☐ Knowledge of anatomical variants and normal anatomy which may mimic trauma
- ☐ Reporting plain radiographs performed to for trauma
- ☐ An awareness of the proper application of other imaging techniques (e.g. computed tomography) in trauma

4.2.20 Paediatric

Core

- ☐ Knowledge of paediatric anatomy and clinical practice relevant clinical radiology
- ☐ Knowledge of disease entities specific to the paediatric age group and their clinical manifestations relevant to clinical radiology
- ☐ Reporting plain radiograph performed in the investigation of paediatric disorders
- ☐ Obtain practical experience in performing ultrasound in the following areas in the paediatric age group
 - Transabdominal
 - Neonatal Head
 - Hips
- ☐ Obtaining practical experience of routine fluoroscopic procedures in the paediatric age group, particularly:
 - Contrast Studies Of The Urinary Tract
 - Contrast Studies Of The Gastrointestinal System
- ☐ Familiarity with the practical management of the following paediatric emergencies:
 - Neonatal Gasrointestinal Obstruction
 - Intussusception
- ☐ Obtaining practical experience in computed tomography and magnetic resonance imaging

4.2.21 Geriatric

Core

- ☐ Knowledge of pathology related to aging
- ☐ Reporting plain radiographs performed on elderly patients
- ☐ Performing routine contrast medium studies in elderly patient

4.3 The trainee should also attain an appropriate level of knowledge in:

- Clinical conditions in which clinical radiology has a role in the diagnosis and / or treatment
- Applied pathology, physiology and medical physics where it contributes to a better understanding of radiological signs and methods of investigation
- Those aspects of clinical medicine and pathology which are essential to the safe and effective conduct of interventional procedures
- Current trends and recent advances in clinical radiology
- Statistics and research methodology

4.4 Assessment

There will be a yearly assessment of all trainees by their supervisor. The aim of these assessments is to:

- Verify experience gained during the preceding 12 months
- Ensure that set targets have been met
- Review clinical, technical and general professional development skills
- Identify any deficiencies in expected knowledge / experience so that these may be remedied in the 12 months
- Set targets for the forthcoming 12 months
- Offer career guidance / counselling as appropriate

The assessment is formalised and completed jointly by the trainee and the supervisors.

4.5 The Part II examination

This is usually conducted at the end of year III which comprises

- 2 MCQ papers (5BA, 1A, 1B, 2A, 2B. each paper 40 questions)
- Film reporting session
- 2 separate viva voce (of two examiners each)

The candidate is deemed to have passed the examination if he/she obtains 50% or more marks for each component of the examination. The candidate who does not fulfil the above requirements shall be deemed to have failed the component concerned but shall be credited with the component or components he/she has passed and be required to repeat the component that he/she has failed.

During this time the candidates will be required to actually start preparation and writing-up of the major project and case reports. Trainees should try and pass the Part II exam at the first attempt to remain in

tandem with the flow of the course. Otherwise, there will be a delay in the preparation and completion of the dissertation project and case reports.

Chapter 5

FOURTH YEAR

5.1 Overview

- 5.1.1 The aim of this year is to consolidate all that has been learnt over the past years towards becoming a consultant radiologist. The trainees should be more involved in the management of patients.
- 5.1.2 The trainee will be exposed to a wider experience in all forms of clinical radiology and applied medical physics.
- 5.1.3 The major project and case reports need to be submitted as determined in the schedules with final submission three months prior to the end of the 4th year.
- 5.2 Active participation in the clinical-radiological meetings in the department is expected.
- 5.3 The trainee will develop skills, as part of his/her general professional development, in:
 - Teaching
 - Research
 - Clinical Audit
 - Management
 - Clinical Standards
 - Quality Standards
 - Communication
 - Information Technology And Computer Literacy
 - Medical Ethics

These aspects of training will require attendance at in-house and / or external meetings and courses at appropriate periods during training.

5.4 Final assessment:

This is usually conducted at the end of the final year which comprises:

- a) Research report
- b) Case report
- c) Viva voce – research & clinical
- d) Rapid film reporting 25 films in 30 minutes.

Chapter 6
DEPARTMENT MANAGEMENT

The Radiologist Physicists in of the department of Biomedical Imaging, Faculty of Medicine, University of Malaya consists of

- ❖ A/Prof. Dr. Khairul Azmi Abdul Kadir (Head of Department)
- ❖ Prof. Ng Kwan Hoong
- ❖ Prof. Dr. Basri Johan Jeet Abdullah
- ❖ Prof. Dr. Gnana Kumar
- ❖ Prof. Dr. Norlisah Mohd Ramli
- ❖ Prof. Dr. Yang Faridah Abdul Aziz
- ❖ Prof. Datin Dr. Sazilah Ahmad Sarji
- ❖ A/Prof. Dr. Roziyah Muridan
- ❖ Prof. Dr. Anushya Vijayananthan
- ❖ A/Prof. Datin Dr. Ouzreiah Nawawi
- ❖ Prof. Dr. Kartini Rahmat
- ❖ A/Prof. Faizatul Izza Rozalli
- ❖ Dr. Farhana Fadzli
- ❖ Dr. Nur Adura Yaakup
- ❖ A/Prof. Raja Rizal Azman Raja Aman
- ❖ A/Prof. Mohammad Nazri Md. Shah
- ❖ Dr. Fadhli Mohamed Sani
- ❖ Dr. Caroline Judy Westerhout
- ❖ Dr. Norshazriman Sulaiman
- ❖ Dr. Shaleen Kaur Kirat Singh
- ❖ Dr. Chan Wai Yee
- ❖ Dr. Chermaine Deepa Anthony (PPUM)
- ❖ Dr. Nadia Fareeda binti Muhammad Gowdh
- ❖ Dr. Ng Wei Lin
- ❖ Dr. Cheah Peng Loon
- ❖ Dr. Eric Chung
- ❖ Dr. Chan Kin Wong
- ❖ Dr. Azlan Che Ahmad
- ❖ A/Prof. Jennie Wong Hsiu Ding
- ❖ Mr. Mohd Shahrin Nizam Ahmad Daman Huri
- ❖ Mr. Tan Li Kuo

2. General office staff
 - Mr. Ahmad Farizan bin Radzuan
 - Mrs. Norlela Yob
 - Mrs. Salmah binti Kassim
 - Mrs. Naja Najwa binti Ahmad Nazir
 - Mr. Noreswandy bin Mohd Yusoff
 - Mr. Muhd Nawawi bin Mohd Tarikh
 - Mr. Salihin Bin Busiroh
3. Chief Radiographer
 - Ms. Hanizan bt Ahamad
4. Sister
 - Mrs. Noor Haniza binti Abu Hassan
5. Radiation Protection officer
 - Mrs. Azleen binti Mohd Zain
6. Medical physicists
 - Mrs. Aminah Mohamed
 - Ms. Sharizan Shaharuddin
 - Mrs. Zamzarinah Kamarul Zaman
 - Mrs. Nurul Khamizah Taharim
 - Mrs. Siti Zubaidah binti Ismail
 - Mrs. Munira binti Mohd Rejab
 - Mrs. Anis Suhana Ahmad Sabri
 - Mr. Wan Mohd Haizily bin Wan Hassan
 - Mrs. Zulaikha binti Jamalludin
 - Ms. Nurul Hidayah binti Moksem
 - Ms. Faizah binti Ahmad
7. RIS Coordinator
 - Ms. Hanizan bt Ahamad
 - Mrs. Ravi Chanthriga
 - Mr. Sayuti bin Mohamad
8. PACS Coordinator
 - Mr. Mohamad Zamri Mohamad Zin
9. Administrator Office
 - Mrs. Normie Ezuanita Binti Suhaimi
10. UMRIC staff
 - Mrs. Sirotul Hidayah binti Abdul Kader
11. CBIE staff
 - Mrs. Khozilah binti Mat Isa
12. Prof Madya Jenny staff
 - Ms. Siti Hafizah binti Mohammad Ya'Acoob
 - Ms. Siti Nur Yasimah binti Mohamad Ali

Chapter 7

DEPARTMENT FACILITIES

Library

The department has collections of both text and reference books. These are kept in the film library and can be used by trainees for reference. These sets of books are meant only for reference and not to be taken out at any time. Electronic journals are available from the university Malaya library

Chapter 8
TEACHING PROGRAMME FOR THE 4-YEAR MASTER OF RADIOLOGY

Housemanship year			
Medical Officer Year/s			
Registration in the Master of Radiology			
Part I	Year 1	Radiological anatomy, radiological techniques, basic trauma & radiological physics	Room postings of 2 weekly each. The trainees are also required to perform their regular daily work to continue their function as a service medical officer. Part I exams
Part II	Year 2	Basic radiological signs and applied Medical Physics Start research project.	2 weekly rotations
	Year 3	Differential diagnosis of radiological signs and applied medical physics. Continue research project & case report writing (to complete at least 2).	2 Weekly rotations * Rotation to PET CT in Putrajaya Hospital Part II exams
	Year 4	Seminars on the role of radiology and applied medical physics in the management of diseases. Submission of research project and case reports.	1 st 6 months: 2 weekly rotations * Rotation to PET CT in Putrajaya Hospital 2 nd 6 months: - * Daily rotations (aim: to function as specialists in making decisions and reporting) - * Subspecialty rotations * For those who pass part II examination at the first attempt Final assessment of research project and case reports

Teaching schedule for the different years

Year	Day of the week
1	Whole day Tuesday
2	Thursday afternoon
3	Friday afternoon

IMPORTANT:-

Trainees are reminded that to be eligible to sit for the examination, all room postings have to be completed satisfactorily. Failure to complete room postings for whatever reason (e.g.; pregnancy or medical leave) may result in the trainee being ineligible for examination.

Chapter 9

CONFERENCES

There are numerous clinical and radiological conferences held in both the department and the medical centre. The idea behind these sessions is for the radiologist to get feedback from the clinician/pathologist on those patients previously investigated. There is an opportunity to know the role of imaging in both the investigation and treatment of patients. These conferences are considered an essential part of the training programme.

UMMC

Clinical Radiological Sessions & Journal Club			
1	Monday	8.00 am - 9.00 am 9.00 am – 10.00 am 1.00-2.00 pm	*Neuroradiological conference * Lung Cancer Breast meeting
2	Tuesday	8.00 am - 9.00 am 12.00 noon	*Radiological Paediatric Conference Department of Radiology. *Journal Club 1 once / month
3	Wednesday	8.00 am - 9.00 am 1.00 pm – 2.00 pm	Clinico-Pathological Conference Clinical Auditorium Neuro-Onco Faculty of Medicine Hepatobiliary & GI
4	Thursday	8.00 am – 9.00 am 11.00am-12.00 noon 1.00 pm – 2.00 pm	Fracture / Radiological – Ortho Conference & O+G / Colorectal / Urology Infectious disease
5	Friday	8.00 am - 9.00 am 9.00 am – 10.00am	*Chest Conference/Film Audit Activity * Paed Surgery Conference

- All trainees rostered irrespective of year of training MUST go through all films or images and discuss with the lecturer-in-charge of the conference. The trainees are also responsible for putting up all films on the panels or upload the images into the computer in the department conference room. With seniority, you are encouraged to take the conference supervised by the lecturer-in-charge. This applies particularly to those with Part II passes. Absence from participation without permission constitutes indiscipline.
- It is also essential that the cases discussed in these meeting be recorded in the respective book to ensure that the interesting cases are not lost. It may be a good idea to try and review these from time to time and then add these cases to the film library.

Chapter 10

RADIOLOGICAL SERVICE

The trainees have the responsibility to obtain their

1. Hospital identification card
2. University matrics card
3. Film badge
4. Annual practising certificate
5. Registration under RIS/PACS system for internal candidates

UMMC

The radiology department In UMMC has numerous rooms for the different radiological investigations. The schedule below is a guideline to the rooms and the schedule. The rooms are on the 2nd floor of Menara Utama and 5th floor Menara Selatan

[5th floor Menara Selatan]

1. This consists of general X-ray rooms . These rooms operate during the office hours. There is a PACS Administration room on the same floor.
2. Ultrasound – consists of 6 ultrasounds room with reporting facilities.
3. Room B1 is the digital fluoroscopy room
4. Nuclear Medicine
5. Fluoroscopy room

Mammography

These are the rooms in the corridor on the way to the operating theatres, at the moment

- | | |
|------------------|---------------------|
| Mammography room | - 1 Reporting room |
| D6 - D8 | - 2 DR mammogram |
| | - 1 Ultrasound room |

[2nd floor Menara Utama]

Consists of 5 rooms. The nursing station is also located here.

- ❖ Room B3 is the biplane angiography suite
- ❖ Room B5 used for the purpose of preparation for the CT patients
- ❖ Room B7 is the Reporting room

CT Scan

This consists of 2 rooms

- ❖ Room C1 contains the Dual-source Multislice CT
- ❖ Room C5 contains the 128 Multislice CT

[Ground floor Menara Utama]

MRI

This is located on the ground floor of the main building and contains the 1.5 Tesla with HIFU capability, 3T and 0.35T open MRI machines

Trauma Centre

This is located in the Trauma Centre building at the ground floor. There is a multi Slice CT, and Digital Radiography (DR).

Cigmit

This is located in the Operation Theater building at the second floor Menara Timur. There is MRI 1.5 and CT Scan 128 Multislice CT

MRI Prisma

Room Posting

All trainees are required to be in their posting rooms latest by at 8.00 am each morning and **PUNCTUALITY cannot** be over emphasized. Permission must be sought with the lecturer-in-charge of the room when there is a need to leave the room. Inform the lecturer if you are involved in a radiological conference for that particular morning and coming in later. You are not allowed to leave the department and hospital premises earlier than 5.00pm other than for conjoint lectures or emergencies (for which prior permission must be sought from the department head or lecturer-in-charge of the room).

Teaching

The best way for the trainees to grasp the fundamentals of what they have learnt is by being involved in teaching (formally or informally). Other than the officially scheduled lectures for the respective years, informal teaching by the academic staff is on a personal arrangement basis and will be largely unofficial. The trainees are also encouraged to teach. In particular, trainees after obtaining their Part II passes (i.e. in Year 4) will be involved in teaching undergraduates (lectures and assignments) as well as their junior colleagues in the masters program.

Leave

All trainees are required to finish their 12-13 days (vacation) and 7 days (hazard) of leave per 6 months. Leave cannot be carried forward without **exception**. Any medical leave taken during this period will be deducted from the leave entitlement. Total annual leave 25 days.

If you exceed your leave entitlement then your training programme will be extended accordingly. At any one time, a fixed number of trainees for each year are allowed leave. Exception may be made on a case-to-case basis. Trainees who, however, are involved in presenting papers at conferences may be given special exemption - subject to the head's approval. Trainees attempting the required examinations (Part I, Part II or repeat) are advised to save 2 weeks of their leave before the examination dates for revision. Non-examination trainees are not to take leave during these periods or when stipulated by the Department Head/Postgraduate Co-ordinator. No leave is allowed for any trainee during any examination week.

Local and Overseas radiological conferences - Funding will be at trainees' own expense. All offers for scholarship or grants must be made known to the Department Head. Priority to attend is given to those presenting papers. This is subject to change.

Maternity leave - this will be considered as own vacation or hazard leave and will be deducted as such.

Emergency leave - you will **need to come to the department** to inform the Head of Department (or the Postgraduate co-ordinator). The nature of emergency leave **must be told**. This is deductible from your annual/radiation leave. Contravening this and increasing frequency of emergency leave can lead to disciplinary action.

Coming in late/leaving department premises

Absence for a period from the room posting cannot be condoned unless with a valid reason (to be informed to either the Department Secretary, Department Head or / and the Postgraduate Coordinator). **A trainee will have to apply for the day's leave if period of absence exceed 2 hours.**

Students in the open system are to attend all classes held according to their schedule. They will be posted in their respective hospitals and will come back to University Malaya for specific postings:-

- Nuclear Medicine
- Angiogram
- MRI
- Mammography

Their leave will be at the discretion of their supervisors in KKM.

SYLLABUS

The detailed syllabus will be available from the Department of Biomedical Imaging.