COLLEGE OF PHYSICIANS AND SURGEONS PAKISTAN

FELLOWSHIP PROGRAMME

DIAGNOSTIC RADIOLOGY

DURATION OF TRAINING 4 YEARS

NOTE: THE CURRICULUM IS APPLICABLE TO BATCHES INDUCTED IN JULY 2025 AND ONWARDS.

2025

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The College of Physicians and Surgeons Pakistan creaders and users of this document. Comments may be sent in writing or by e-mail to the CPSP at:

DIRECTORATE OF NATIONAL RESIDENCY PROGRAM (DNRP)
College of Physicians and Surgeons Pakistan (CPSP)
7th Central Street, Defence Housing Authority, Karachi-75500.
nrp@cpsp.edu.pk

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ABOUT THE COLLEGE

The College was established in 1962 through an ordinance of the Federal Government. The objectives/functions of the College include promoting specialist practice of Medicine, Obstetrics & Gynaecology, Surgery and other specialties by securing improvement of teaching and training, arranging postgraduate medical, surgical and other specialists training, providing opportunities for research, holding and conducting examinations for awarding College diplomas and admission to the Fellowship of the College.

Since its inception, the College has taken great strides in improving postgraduate medical and dental education in Pakistan. Competency-based structured Residency Programs have now been developed, along with criteria for accreditation of training institutions, and for the appointment of supervisors and examiners. The format of examinations has evolved over the years to achieve greater objectivity and reliability in methods of assessment. The recognition of the standards of College qualifications nationally & internationally, particularly of its Fellowship, has enormously increased the number of trainees and consequently the number of training institutions and the supervisors. The rapid increase in knowledge base of medical sciences and consequent emergence of new sub-specialties have gradually increased the number of CPSP fellowship disciplines to eighty nine including specialties in dentistry.

After completing two years of core training during IMM, the trainees are allowed to proceed to the advance phase of FCPS training in the specific specialty of choice for 2-3 years. However, it is mandatory to qualify IMM examination before taking the FCPS-II exit examination. The work performed by the trainee is to be recorded in the e-logbook on daily basis. The purpose of the e-log is to ensure that the entries are made on a regular basis and to avoid belated and fabricated entries. It will hence promote accuracy, authenticity and vigilance on the part of trainees and the supervisors.

The average number of candidates taking CPSP examinations each year is to a minimum of 32,000. The College conducts examinations for FCPS-I (11 groups of disciplines), IMM, FCPS-II (89 disciplines), MCPS (22 disciplines), including MCPS in Health Professions Education and Health Care System Management. A large number of Fellows and senior medical teachers from within the country and overseas are involved at various levels of examinations of the College.

The College, in its endeavor to decrease inter-rater variability and increase fairness and transparency, is using TOACS (Task Oriented Assessment of Clinical Skills) in IMM and FCPS-II Clinical examinations. Inclusion of foreign examiners adds to the credibility of its qualification at an international level. It is important to note that in the overall scenario of health delivery over 85% of the total functioning and registered health care specialists of the country have been provided by the CPSP. To coordinate training and examination, and provide assistance to the candidates stationed in cities other than Karachi, the College has established 14 Regional Centers (including five Provincial Headquarter Centers) in the country. The five Provincial Headquarter Centers, in addition to organizing the capacity building workshops/short courses also have facilities of libraries, I.T, and evaluation of synopses along with providing guidance to the trainees in conducting their research work. The training towards Fellowship can be undertaken in more than 343 accredited medical institutions throughout the country and 95 accredited institutions abroad. The total number of trainees in these institutions is over 38,668 who are completing residency programs with around 6,096 supervisors. These continuous efforts of the College have even more importantly developed a credible system of postgraduate medical education for the country. The College strives to make its courses and training programs 'evidence' & 'needs based' so as to meet international standards as well as to cater to the specialist healthcare needs not only for this country but also for the entire region.

Prof. Khalid Masood Gondal
President,
College of Physicians and Surgeons Pakistan

FELLOWSHIP DISCIPLINES

The list of fellowship programmes, first & second fellowship, are given below:

DISCIPLINES FOR FIRST FELLOWSHIP

1. Anatomy
2. Anesthesiology
3. Biochemistry
4. Cardiac Surgery
5. Cardiology
6. Cardio Thoracic Anaesthesia
7. Chemical Pathology
8. Clinical Haematology
9. Community Medicine
10. Dermatology
11. Diagnostic Radiology
12. Emergency Medicine
13. Family Medicine
14. Forensic Medicine
15. Haematology
16. Histopathology
17. Immunology
18. Medicine
19. Medical Oncology
20. Microbiology
21. Nephrology
22. Neurology
23. Neurosurgery
24. Nuclear Medicine
25. Obstetrics And Gynaecology
26. Operative Dentistry & Endodontics
27. Ophthalmology
28. Oral & Maxillofacial Surgery
29. Orthodontics
30. Orthopaedic Surgery
31. Otorhinolaryngology (ENT)
32. Paediatric Surgery
33. Paediatrics
34. Periodontology
35. Pharmacology and Therapeutics
36. Physical Medicine & Rehabilitation
37. Physiology
38. Plastic Surgery
39. Prosthodontics
40. Psychiatry
41. Pulmonology
42. Radiation Oncology
43. Surgery
44. Thoracic Surgery
45. Urology
46. Virology

DISCIPLINES FOR SECOND FELLOWSHIP

1. Breast Surgery
2. Child and Adolescent Psychiatry
3. Clinical Cardiac Electrophysiology
4. Community & Preventive Paediatrics
5. Colorectal Surgery
6. Critical Care Medicine
7. Cytopathology
8. Developmental and Behavioural Paediatrics
9. Endocrinology
10. Gastroenterology
11. Glaucoma
12. Gynecological Oncology
13. Hepato-Pancreato-Biliary and Liver Transplant Surgery
14. Infectious Diseases
15. Interventional Cardiology
16. Interventional Radiology
17. Maternal and Fetal Medicine (MFM)
18. Molecular Pathology & Cytogenetics
19. Neonatal Paediatrics
20. Orbit And Oculoplastics
21. Paediatric Cardiology
22. Paediatric Critical Care Medicine
23. Paediatric & Congenital Cardiac Surgery
24. Paediatric Endocrinology & Diabetes
25. Paediatric Dermatology
26. Paediatric Gastroenterology and Hepatology
27. Paediatric Haematology Oncology
28. Paediatric Infectious Diseases
29. Paediatric Nephrology
30. Paediatric Neurology
31. Paediatric Ophthalmology and Strabismus
32. Paediatric Orthopaedic Surgery
33. Paediatric Pulmonology
34. Pain Medicine
35. Palliative Medicine
36. Reproductive Endocrinology & Infertility
37. Rheumatology
38. Spine Surgery
39. Surgical Oncology
40. Transplant Nephrology
41. Urogynaecology
42. Vitreo Retinal Ophthalmology
43. Vascular Surgery

CPSP COMPETENCY MODEL

College of Physicians and Surgeons Pakistan has moved to competency-based medical education and has developed its own competency model shown below. A generic explanation of the model is given below and it is expected that all its residency training programmes follow the components of this model in accordance to the requirements of each specialty.

Patient or population care occupies the pivotal center. Patient care includes all clinical skills such as history taking, physical examination, ordering investigations, making diagnoses and managing the care. The inner leaves of the model represent the five major competencies directly related to patient care, while the three competencies in the outer circle are mega-competencies related to patient care and also incorporate education, professionalism, leadership, advocacy and population health.

By the end of the Residency Programme, residents are expected to acquire these competencies and their constituent learning outcomes, and provide promotive, preventive, curative and rehabilitative patient-centered (or population-centered) care.

Inner Leaves:

1. Knowledge and Critical Thinking
2. Technical Skills
3. Communication Skills
4. Teamwork
5. Research

Outer Leaves:

6. Professionalism
7. Pedagogy
8. Advocacy

1. Knowledge and Critical Thinking

- Demonstrate application of wide and current readings to critical thinking and problem solving
- Relate the alteration of body function to the presenting condition
- Interpret and integrate history and examination findings to arrive at an appropriate provisional and credible differential diagnoses
- Sequentially order, justify and interpret appropriate investigations
- Apply knowledge and reasoning skills to
    - Analyze data for problem identification and to rule in and rule out contending conditions
    - Synthesize and evaluate solutions for decision-making in solving familiar and less familiar problems based on best current evidence
    - Prioritize different problems within a time frame
    - Select, outline and provide, with evidence-based justifications, appropriate pharmacological and non-pharmacological management strategies
    - Assess new medical knowledge and apply it to resolve patient problems (Evidence-based practice)
    - Apply quality assurance procedures in daily work (Professionalism)
    - Demonstrate shared-decision-making with the patient or family
    - Provide cost-effective care while ordering investigations and in management
    - Use resources appropriately
    - Demonstrate awareness of bio-psycho-social factors in assessment and management of a patient

2. Technical Skills

- Demonstrate International Patient Safety Goals (IPSG)
- Demonstrate competent performance of all required technical skills and procedures in the specialty, including:
  - Obtaining informed consent
  - Preoperative planning
  - Pre-interventional care and preparation
  - Intra-Intervention techniques including exposure and closure, global & task specific items, and communication and teamwork skills
  - Post-interventional care
  - Follow-up care

3. Communication Skills

Written Communication Skills:

- Maintain clear, concise, accurate & updated medical records
- Write:
  - Cogent, clear progress notes documenting working diagnosis & status of diagnostic evaluation
  - Clear, focused, evidence-based & logical management plans and discharge summaries
  - Respectful, clear & focused letters and referrals to other colleagues

Verbal and other Non-verbal Communication Skills:

- Clear, focused and logical presentation of cases
- Demonstrate:
  - Effective interpersonal communication skills by being clear, considerate and sensitive towards patients, their relatives, other physicians, health professionals, team members, colleagues, students and the public
    - Empathy & respect towards patients & their relatives
    - Effective counseling of the patient and the family with cultural sensitivity by explaining options, educating them & promoting joint decision-making
    - Appropriate verbal & body language on the campus and all work situations including seminars, bedside sessions, outpatient sessions and others
    - Respect and tolerance for all health care professionals, including peers, juniors and seniors
    - Appropriate conflict resolution & management skills

4. Teamwork

- Demonstrate constructive team-communication skills
- Facilitate collaborative group interaction as a team member to build strong teams demonstrating respect, tolerance and interdependence
- Support other team members to grow
- Demonstrate willingness to assume responsibility and leadership as needed

5. Research

- Conduct a research study individually or in a group by using appropriate
    - Selection of research question(s) and objectives
    - Research design and statistical methods to answer the research question
    - REU approval of the synopsis
- Demonstrate competence in academic writing by publishing research article(s) as a step towards resolving issues or concerns in their specialty
- Guide others in conducting research by advising about research methodology including study designs and statistical methods
- Demonstrate clear, focused & logical presentations of their research
- Interpret & use results of various research studies (critical appraisal)

6. Professionalism

- Demonstrate the highest level of personal integrity: honesty, punctuality, regularity, timely task completion
- Deal with all patients in a non-discriminatory, prejudice-free manner, demonstrating the same level of care for every human being irrespective of gender, age, ethnic background, culture, socioeconomic status & religion
- Establish a trusting relationship with patients, their relatives and care-givers
- Deal with all patients with honesty, empathy & compassion, putting patients' needs first (altruism)
- Facilitate transfer of information important for promotion of health, prevention and management of disease

- Encourage questioning by the patient and be receptive to feedback
- Pursue self-directed and life-long learning. Keep abreast of medical literature and assess new knowledge and apply it to resolve patient problems
- Know one's limitations and ask for help as needed from colleagues, consultations or referrals
- Apply quality assurance procedures for improvement in daily work
- Be a role model for others

Ethics
- Maintain patient autonomy by demonstrating shared-decision-making with the patient and/or family
- Obtain informed consent, maintain patient confidentiality and do no harm
- Provide cost-effective care while ordering investigations and in management and use resources appropriately

Leadership
- Demonstrate accountability for their decisions and actions, and that of their team
- Demonstrate willingness to assume leadership role(s) when needed in given situations or events (rush call/code)
- Change and bring about change as necessary, as a leader or supportive leader

7. Pedagogy
- Demonstrate effective teaching skills, including clinical and community-based teaching, using diverse strategies
- Apply theories regarding learning & education in teaching practices
- Practice effective teaching methods, including the use of technology and multimedia tools to enhance learning experiences
- Mentor junior colleagues and residents, providing guidance and support
- Provide constructive feedback to resident learners
- Participate in continuous professional development through workshops and courses

- Reflect on teaching experiences for personal growth and improvement
- Lead educational initiatives & foster an inclusive learning environment

8. Advocacy

Advocacy is needed at multiple levels.

- Advocacy for the Patient:
  - Act as advocates for patients to ensure they are not lost in the system
  - Deliver timely care, prioritizing the patient's needs first
- Advocacy for the Practice:
  - Highlight limitations & issues within the service or practice
  - Identify solutions to problems and recommend and implement improvements for the practice(s) and institutional system(s)
- Advocacy for the Health System and Society:
  - Describe one's role in the health system(s) & contribute to building strong referral systems
  - Prioritize patient and community interests above personal or professional interests
  - Advocate for the elimination of social determinants of ill health
  - Advocate for the prevention of serious illnesses within one's specialty/sub-specialty
- Advocacy for the Profession:
  - Strive to build public trust in the medical & dental profession
  - Demonstrate efforts to improve and enhance the profession, specialty, and sub-specialty
  - Serve as conscientious gatekeepers of one's profession, specialty, and sub-specialty

Candidates will be admitted to the fellowship residency programme including examinations in the name (surname and other names) as given in the MBBS degree. CPSP will not entertain any application for change of name on the basis of marriage/divorce/deed.

ELIGIBILITY REQUIREMENTS FOR ENTERING THE FELLOWSHIP PROGRAM IN DIAGNOSTIC RADIOLOGY

- Passed FCPS-I in Diagnostic Radiology or granted exemption

DURATION OF TRAINING

The total duration of fellowship training extends for 4 years divided into Intermediate Module (IMM) consisting of first two years and the advance phase of training (FCPS-II) extending for further two years. Upon completion of IMM training the residents become eligible to appear in Intermediate Module examination.

APPROVED TRAINING CENTERS

Training must be undertaken in units, departments and institutions approved by the College. A current list of approved institutions is available from the College and its Regional Centers as well as on the College website: www.cpsp.edu.pk

REGISTRATION AND SUPERVISION

All training must be supervised and residents are required to register with the RTMC and submit the name of their supervisor(s) by the date indicated on the registration form. The supervisor will normally be a Fellow of the College.

ROTATIONS

The specialty of Diagnostic Radiology prescribes its residents to acquire competencies in following areas in addition to the training in the primary specialty:

Intermediate Module (IMM):

- Nuclear Medicine: **4 weeks**

Post IMM (FCPS-II):

- Vascular and Interventional Radiology: **4 weeks**

Rotational Policy:

CPSP wishes to be more Resident friendly in its policies regarding rotations as given below:

- CPSP prefers that all rotations must be completed within the same hospital in which the primary specialist training unit is located
- In case, a specific rotational unit is not present in a given hospital but the primary unit is capable to deal with competencies related to those rotations, the parent supervisor can verify the entries for those rotational competencies and there will be no need to send the residents to a rotational unit outside the parent hospital
- The Residents will be sent for rotations outside the parent hospital only in cases where the acquisition of rotational competencies in parent hospital is not possible. The rotational competencies are laid down in the curriculum by the Faculty of the program. The parent supervisor shall make the requisition for the rotation to a specific center within the same city, preferably to a hospital with which an MoU is already signed. The duly approved supervisor of that rotational unit will supervise and verify the entries made by the resident and, shall also issue a rotation completion certificate (to be countersigned by the parent supervisor)
- The primary responsibility of verification of e-portal entries shall be of the rotational supervisor (if any), but the e-portal entries shall also be visible to the parent supervisor
- No resident, including for elective rotation, will be sent for rotation outside the city without prior permission of the Competent Authority, processed through NRP committee

RESEARCH

Vide notification numbers CPSP/Sec/2024/45 dated 15th March, 2024, F-1/Exam-24/CPS/3008-A dated 30th August, 2024, and CPSP/Sec/2024/454 dated 09th September, 2024.

- Residents inducted in the CPSP 1st fellowship programs from January 2025 and onwards, will be required to provide evidence of publication of one research paper in a CPSP approved journal, for appearing in final fellowship examination
- Synopsis duly approved by the supervisor must be submitted to the REU of CPSP before six (06) months of scheduled IMM examination
- Synopsis of the research paper must be approved by the Research & Evaluation Unit (REU) of CPSP before starting the research work
- The evidence of publication of one research paper in a CPSP approved journal must be submitted along with the final FCPS-II examination form

MANDATORY WORKSHOPS AND COURSE

It is mandatory for all Intermediate Module trainees to attend following CPSP certified workshops in the two years of training:

1. Introduction to Computer and Internet
2. Research Methodology, Biostatistics & Article Writing
3. Skills for Communication, Orientation, Professionalism & Ethics (SCoPE)
4. Basic Life Support (BLS) Course

Any other workshop/s and course/s as may be introduced by the CPSP.

NOTE: 1) The workshops are conducted by the Directorate of Medical Education and the candidates are advised to get registered online. The BLS course is conducted by the Advanced Skills Department (ASD) and the registration form is to be submitted with the ASD separately.

2) No candidate will be allowed to appear in IMM examination without attending the above mentioned workshops and BLS course.

TRAINING PROGRESSION

Training should incorporate the principle of gradually increasing responsibility, and provide each resident with a sufficient scope, volume and variety of experience in a range of settings that include inpatients, outpatients, emergency and intensive care. The emphasis during IMM training shall be on fundamentals of radiology and essential concepts of trauma, critical care and most common diseases. Upon completion of IMM training residents become eligible to appear in IMM examination. However, because of the seamless nature of fellowship training residents can directly proceed to the next phase of training.

E-LOGBOOK

The CPSP council has made e-logbook system mandatory for all Residency programme residents inducted from July 2011. Upon registration with RTMC each resident is allotted a registration number and a password to log on and make entries of all work performed and the academic activities undertaken in e-logbook on a daily basis. The concerned supervisor is required to verify the entries made by the resident. This system ensures timely entries by the resident and prompt verification by the supervisor. It also helps in monitoring the progress of residents and the vigilance of the supervisors.

AWARD OF FELLOWSHIP

Fellowship of the College of Physicians and Surgeons Pakistan is awarded to those applicants who have:

- A recognized dental degree
- Completed one year house job in an institution recognized by PMDC/PMC
- Passed the relevant FCPS Part-I in Dentistry examination or granted exemption
- Registered with the Research & Training Monitoring Cell (RTMC)
- Undergone specified years of supervised accredited training on whole time basis
- Passed IMM examination in Diagnostic Radiology
- Declared successful in final fellowship examinations carried out by the examination department of the CPSP
- Submitted evidence of publication of one research paper in a CPSP approved journal
- Elected by the college council

TRAINING ENQUIRES AND REGISTRATION

All residents should notify the College in writing of any change of address and proposed changes in training (such as change of supervisor, change of department, break in training etc.) as soon as possible.

ROLES AND RESPONSIBILITIES
SUPERVISOR

Supervision of a resident is a multifaceted job. Arbitrarily the task is divided into the following components for the sake of convenience. This division is by no means exhaustive or rigid. It is merely meant to give semblance to this abstract and versatile role.

EXPERT TRAINER

- This is the most fundamental role of a supervisor. S/he has to not only ensure and monitor adequate training but also provide continuous helpful feedback (formative) regarding the progress of the training
- This would entail observing the resident's performance and rapport with all the people within his/her work environment
- S/he should teach the residents and help them overcome the hurdles during the learning process
- It is the job of the supervisor to make the residents develop the ability to interpret findings in their patients and act suitably in response
- The supervisor must be adept at providing guidance in writing a research article (which is an essential component of training)
- Every supervisor is required to participate actively in Supervisors' workshops, conducted regularly by CPSP, and do his/her best to implement the newly acquired information/skills in the training. It is his/her basic duty to keep abreast of the innovations in the field of expertise and ensure that this information percolates to residents of all years under him/her

RELIABLE LIAISON

- The supervisor must maintain regular contact with the College regarding training and the conduct of various mandatory workshops and courses
- It is expected that the supervisor will establish direct contact with relevant quarters of CPSP if any problem arises during the training process, including the suitability of resident
- S/he must be able to coordinate with the administration of his/her institution/organization in order to ensure that his/her residents do not have administrative problems hampering their training

PROFICIENT ADMINISTRATOR

- The supervisor must ensure that the residents regularly fill their e-logbook
- S/he must provide quarterly feedback regarding each resident through e-log system
- S/he might be required to submit confidential reports on resident's progress to the College
- The supervisor should notify the College of any change in the proposed approved training program
- In case the supervisor plans to be away for more than two months, he/she must arrange satisfactory alternate supervision during the period

ROLES AND RESPONSIBILITIES
RESIDENT

Given the provision of adequate resources by the institution, residents should

- Accept responsibility for their own learning and ensure that it is in accord with the requirements of the particular discipline
- Play an informed role in the selection of the supervisor
- Seek reasonable infrastructure support from their Institution and supervisor, and use this support effectively
- Ensure that all outlined aspects of training are covered during the defined training period
- Work with their supervisors in writing the synopsis and submit the synopsis duly approved by the supervisor with the REU department before six (06) months of their scheduled IMM examination
- Accept responsibility for the research and plan to execute it within the time limits defined
- Be responsible for arranging regular meetings with the supervisor to discuss and document progress. If the supervisor is not able/willing to meet with the resident on a regular basis, he/she must notify the college
- Provide the supervisor with word processed updated synopsis subsequent research paper draft (ensure it has been checked for spelling, grammar and typographical errors, prior to submission) and provide the raw data to the supervisor if required
- Submit evidence of publication of one research paper in a CPSP approved journal, along with examination form
- Follow the College complaint procedure if serious problem arises

AIM AND OBJECTIVES

The aim of the Fellowship Programme in Diagnostic Radiology is to produce specialists in the field who have attained the required competencies. By the end of the residency programme, the graduate will be able to:

OBJECTIVES

- Justify imaging protocols according to clinical presentation
- Manage the problem in a cost effective manner
- Be an effective team player, leading the team if necessary
- Communicate effectively with:
  - Patients and their attendants with empathy and compassion, in interviewing, counseling, breaking bad news, behavioural modification and shared decision making, recognizing the impact of the condition on the patients and their families
  - Seniors, peers, juniors, learners and other health professionals;
- Comprehend risk analysis & place emphasis on prevention
- Ensure patient safety
- Write appororiate reports of imaging, describing the pathology corelating it with clinical presentation and giving appropriate diagnosis/differential diagnosis and recommend further steps and management
- Keep up to date and practice evidence based medicine
- Demonstrate putting patients first
- Demonstrate honesty, integrity and timeliness (punctuality and task completion)
- Establish, organise and plan teaching and research programmes.
- Regularly take active part in academic activities like journal club, case presentations, audits, morbidity & mortality meetings/discrepancy meetings, multidisciplinary team meetings and tumor boards.

INTERMEDIATE MODULE (IMM) DIAGNOSTIC RADIOLOGY

ROTATION

- Nuclear Medicine: **4 weeks**

GENERAL GUIDELINES

The Structured Training Programme for Intermediate Module of Diagnostic Radiology will address:

Emergency Radiology, Conventional & General Radiology

Intermediate Module builds foundation for advance training in Diagnostic Radiology. Hence the difference between the Intermediate module and FCPS will be based on level of complexity of the content. The listing is for the minimal levels of knowledge, skill and experience.

The core knowledge for each system-based module includes physics, detailed radiological anatomy and techniques.

The trainee is expected to have knowledge of how multi system disease manifests itself.

Technique-based subspecialties (CT, MRI, US, interventional and radionuclide radiology) are incorporated within each system-based module.

The framework for core training will consist of training in various sections (subspecialties) of the department which should give appropriate experience in the areas identified below:

System-Based Sub-specialties:

- Breast imaging
- Cardiac imaging
- Gastrointestinal
- Head & neck imaging including ear, nose, throat& dental
- Musculoskeletal
- Neuroradiology
- Women imaging
- Thoracic imaging
- Uroradiology

- Vascular imaging including intervention
- Radionuclide radiology
- Paediatric imaging

LEARNING OUTCOMES

Core Knowledge and Critical Thinking

At the end of two years of residency, the resident comprehends and is able to describe:

- Anatomy and Normal Variants
  The topographic anatomy as displayed by modern imaging techniques
- Common Pathologies and Emergency Clinical Conditions
- Current Ionizing Radiation Protection Principles
  The rules and regulation of Pakistan and its other governing agencies like Pakistan Nuclear Regulatory Authority (PNRA)
- Guidelines and regulations of radiation protection for medical, radiographic staff and patients, both for clinical practice and research purposes

Imaging Equipment

The resident is able to explain:

- The basic principles of ultrasound, CT, MRI and radionuclide imaging
- The nature of the radiation/electromagnetic/sounds waves used in different techniques
- The performance of imaging equipment as well as the means by which the relevant images are created
- The standard radiographic projections relating to the regions outlined in the radiological anatomy syllabus and to be able to give practical advice on improving the quality of the image obtained
- The techniques, including the materials (e.g. contrast agents, pharmacological agents) and equipment (e.g. catheters, needles) used in these techniques which a candidate is expected to have carried out personally
- The basic interventional procedures e.g. pleural and ascitic tap, fine needle asparation (FNA)

CORE CONCEPTS OF IMAGING INFORMATICS

Standard

- **DICOM:** The Digital Imaging and Communications in Medicine (DICOM) standard (http://dicom.nema.org) is the international standard that specifies protocols for display, transfer, storage, and processing of medical images.
- **HL7:** HL7 (http://www.hl7.org) is the international standards organization responsible for developing and maintaining standards for the exchange, integration, sharing, and retrieval of medical information (i.e., nonimage data). The primary HL7 standards are the ones most frequently used to achieve systems interoperability.

The Reading Room Environment

- **PACS:** The PACS (picture archiving and communications system) is the radiologist's primary tool for imaging viewing and interpretation. Basic components of PACS include a workstation, display, short-term storage, and long-term archive. PACS communicates with imaging modalities using DICOM transactions, and with the RIS and/or EMR using HL7 transactions that are translated to and from DICOM
- **VNA:** The development of the vendor-neutral archive (VNA) allows data to be stored in a central archive that may support viewers for multiple types of DICOM images (e.g., radiology, cardiology, operating room, etc.), as well as for non-DICOM data, including photographs and pathology slides. Enterprise imaging relies heavily on VNA technology to facilitate dissemination, viewing, and storage of medical imaging data beyond radiology.
- **RIS:** The radiology information system (RIS) is a software application that manages all aspects of an imaging exam, including order reconciliation, patient scheduling and tracking, communication with modalities and PACS, reporting, results notification, and billing. The RIS may be a standalone application or a component of the electronic medical record (EMR) application. Both PACS and RIS can be used to drive clinical workflow.

- **IMAGE DISPLAYS, COMPRESSION, ERGONOMICS**

Workflow Considerations

- Workflow Steps
- Downtime Procedures

Data Privacy And Security

- **DE-IDENTIFICATION OF IMAGES:** De-identification involves removing protected health information (PHI), from an imaging examination such that the identity of the patient cannot be directly determined based on information contained in the images or the metadata. However, de-identified images may contain information that enables an approved entity to identify the patient using a key. In contrast, anonymization involves removing all PHI and other identifiable data from an imaging examination such that the identity of the patient is not revealed and cannot be re-established in the future.
- **DE-IDENTIFICATION OF REPORT TEXT**

Image Post-processing: "Post-Processing" refers to image transformations performed after the image has been acquired. These transformations may be performed before image display, interpretation, or quantitative analysis. Post-processing includes techniques such as image segmentation, registration, and iterative reconstruction.

Artificial Intelligence: Artificial Intelligence (AI) is the field of computer science that gives computers the ability to mimic human intelligence. Machine learning (ML) is a subfield of AI that enables computers to learn a task without being given an explicit set of instructions. Deep learning (DL) uses multi-layered neural networks with weighted connections to analyze images and text.

Essential Topics for Radiology Practice

- Radiation safety
- Contrast reaction management
- MRI contraindications and safety considerations
- Professionalism
- Best practices

- Key performance measures
- Malpractice, ethics, critical thinking
- Six Sigma (methodologies for improvement of processes)
- Concept of Quality Management System in Healthcare
- Quality Assurance (equipment and clinical practice)
- Safety Management and risk Management:

Safety Goals (IPSG)

Identify patients correctly by:

- Using two identifiers (patient's name and medical record number)
- Improving effective communication
- Limiting telephonic and verbal orders for urgent/ emergency situations only
- Reading-back and verify all telephonic/verbal orders and all critical/panic tests

Observing other safety goals by:

- Reducing the risk of health-care associated infections
- Eliminating infections by proper hand hygiene
- Washing hands before and after patient contact
- Reducing the risk of patient harm resulting from falls
- Assessing fall risk of all patients
- Initiating fall prevention protocol
- Reassessing for fall risk during hospitalization
- Ensuring correct-site, correct-procedure, correct intervention
- Marking Surgical / invasive procedure site appropriately
- Verifying all documents and equipment needed before surgery/procedure
- Observing 'Time-out' before surgery and invasive procedures
- Improving the safety of high-alert medications
- Taking caution with concentrated electrolytes, chemotherapeutic, antithrombolytics drugs, looking alike and sound alike drugs in regular patient care units

Communication Skills

- Read and dictate radiographs, ultrasound, CT and MRI of common diseases under direct supervision of the attending radiologist
- Participate in reporting sessions
- Plan proper MRI/CT examination of the common diseases and to adapt it to the individual situation
- Demonstrate effective verbal communication skills
- Recognize and communicate life threatening conditions
- Participate in the multidisciplinary meetings and tumor boards
- Obtain informed consent prior to interventions
- Demonstrate effective counseling skills
- Demonstrate effective presentation and teaching skills

Professionalism: Core Elements
Commitment to:

- Professional competence
- Honesty with patients
- Patient confidentiality
- Maintaining appropriate relations with patients
- Improving quality of care
- Improve access to care
- Just distribution of finite resources
- Scientific knowledge
- Maintain trust by managing conflicts of interest
- Professional responsibilities

Ethical Considerations Specific to Radiology

- **Professional limitations:**
  Radiologists should be aware of their limitations and to seek consultations in clinical situations where appropriate.

- **Reporting Of Illegal or Unethical Conduct:**
  To safeguard the public and the profession against physicians deficient in moral character or professional competence, radiologists are expected to report any perceived illegal or unethical conduct of medical professionals to the appropriate governing body.

- **Report Signature:**
  Radiologists should not sign a report or claim attribution of an imaging study interpretation that was rendered by another physician, making the reader of a report believe that the signing radiologist was the interpreter.

- **Participation In Quality And Safety Activities:**
  Should participate in quality assurance, technology assessment, utilization review, and other matters of policy that affect the quality and safety of care.

- **Self-Referral:**
  Referring patients to healthcare facilities in which radiologists have a financial interest is not in the best interest of patients and may violate the Rules of Ethics.

- **Harassment:**
  Radiologists are expected to relate to other members of the healthcare team with mutual respect and refrain from harassment or unfair discriminatory behavior.

- **Financial Dishonesty:**
  Expert Medical Testimony:
  Radiologists should exercise extreme caution to ensure that the testimony provided is nonpartisan, scientifically correct, and clinically accurate. Compensation that is contingent upon the outcome of litigation is unacceptable.

- **Research Integrity:**
  Plagiarism:
  Misleading Publicizing:
  Radiologists should not publicize themselves through any medium or forum of public communication in an untruthful, misleading, or deceptive manner.

- **Research Skills**
- Interpret and use results of various research studies in imaging (critical appraisal)
- Assist in research activities in a group by using appropriate research methodology and statistical methods

Attitudes:

Towards Self:

- Recognize limitations in personal skills and knowledge in diagnostic workup, ensuring all decisions, dictations and consultations are under direct supervision of the supervisor

Towards Patients:

- Establish a positive relationship with patients in order to build trust and ease illness and sufferings
- Internalize the concept of confidentiality and respect of the patient regardless of gender, age, ethnic background, culture, socioeconomic status and religion
- Internalize and always adhere to the Rule of TEN and principles of ALARA in imaging reproductive age group ladies
- Identify problems in practice and recommend improvements

Towards Society:

- Comprehend the social and governmental policies of health care and devise cost effective professional care
- Demonstrate the knowledge of available resources

https://www.theabr.org/wp-content/uploads/2021/12/2022-NIS-Study-Guide.pdf

SYLLABUS

The syllabus is divided into various sections with specific objectives given for each section/sub-section as needed.

RADIOLOGICAL PHYSICS

1. Structure of the Atom, Electromagnetic Radiation, and Particulate Radiation

Fundamental Knowledge:

- Components of the atom.
- Energy levels, binding energy, and electron transitions in an atom.
- Nucleus of an atom, its properties, how these properties determine its energy characteristics, and how changes within the nucleus define its radioactive nature.
- Atom and how its electron/nuclear structure & associated energy levels define its radiation-associated properties.
- Different transformation ("decay") processes within the nucleus of an atom, determine the type of radiation produced and the classification of the nuclide.
- Wave and particle characteristics of electromagnetic (EM) radiation.
- EM radiation spectrum and the properties associated with energy and the ability to cause ionization.
- Different categories and properties of particulate radiation.

2. Interactions of Ionizing Radiation with Matter

Fundamental Knowledge:

- Charged particles interaction with matter and the resulting effects these interactions can have on the material.
- Processes by which x-ray and g-ray photons interact with individual atoms in a material and the characteristics that determine which processes are likely to occur.
- Attenuation of photons and charged particles within a material and the terms used to characterize the attenuation

Clinical Application:

- Dominant Photon interactions for the imaging modalities such as mammography, projection radiography, fluoroscopy, CT and various nuclear medicine radioactive isotopes
- Effect of photon interactions on image quality and patient dose
- X-ray beam energies and their use with intravenous iodine and oral barium contrast agents
- Types of photon interactions; their change with energy and associated clinical significance
- Reasons for charged particle interactions resulting in a high localized dose

3. Radiation Units and Measurement

Fundamental Knowledge:

- Two different systems for units of measurement (i.e., SI and traditional) used to describe physical quantities.
- SI and traditional units for measuring the ionization resulting from radiation interactions in air (e.g., exposure-related quantities).
- Concepts of dose-related quantities and their SI and traditional units.

Clinical Application:

The appropriate use or applicability of radiation quantities in the health care applications of imaging, therapy, and safety

4. X-Ray Production

Fundamental Knowledge:

- Two mechanisms by which energetic electrons produce x-rays and the energy distribution for each mechanism of x-ray production.
- Function of the cathode and anode of an x-ray tube and how variations in their design influence x-ray production.
- Technique factors used in diagnostic imaging kV, mA, exposure time, mAs.
- Attributes of an x-ray beam, including the functions of filtration, spectrum of energies produced & beam restriction

- Heel effect and how it can be used to improve clinical radiographs.

Clinical Application:
- How the x-ray tube design, target material, tube voltage, beam filtration, and focal spot size are optimized for a specific imaging task (e.g., mammography, interventional imaging, or CT).

5. Basic Imaging

Fundamental Knowledge:
- Common descriptive statistics (e.g., mean, variance, etc.) used in the radiology literature.
- Metrics and methods used to measure image quality and assess imaging systems.
- Characteristics of a display and how they interact with the human visual system to impact perceived image quality.
- Basic concepts of image processing and image archiving.

Objectives:
By the end of two years of training the resident will be able to:
- Assess the validity of the type of statistical analysis used in the radiology literature.
- Evaluate how display, ambient lighting, and luminance affect reader performance.
- Develop custom hanging protocols for display of images.
- Display the understanding of quality control.
- Demonstrate the DICOM standard.

6. Biological Effects of Ionizing Radiation

Objectives:
By the end of two years of training the resident will be able to:
- Describe the cell cycle, and discuss the radio-sensitivity of each phase.
- Discuss how the dependence of cell survival is related to LET.
- Define the principles of how radiation deposits energy that can cause biological effects.

- Explain the difference between direct and indirect effects, how radiation affects DNA and how radiation damage can be repaired.
- Compare the radio-sensitivities of different organs in the body.
- Comprehend the thresholds for deterministic effects, including cutaneous radiation injury, cataracts, sterility, and whole-body acute radiation syndromes.
- Explain the risk of carcinogenesis due to radiation.
- Comprehend the latencies for different cancers.
- Describe the effect of radiation on mutagenesis and teratogenesis.
- List the most probable in utero radiation effects at different stages of gestation.
- Describe the different dose response models for radiation effects.
- Recognize the risk vs. benefit in radiation uses, and recognize the information sources that can be used to assist in assessing these risks.
- Discuss the effect & control of scatter beam, compression, grid construction & operation (Scattered radiation).

Clinical Application:

- Risks to patients from high-dose fluoroscopy regarding deterministic effects, such as cutaneous radiation injury and cataractogenesis, and the importance of applying radiation protection principles in clinical protocols to avoid damage.
- Risks to the female breast (including age dependence).
- Counseling of pregnant women on the potential radiation risks to the fetus.
- Effects of massive whole-body irradiation and how it is managed.

7. Radiation Protection and Associated Regulations

Objectives:

By the end of two years of training the resident will be able to:

- Comprehend the Statutory Requirements and Non-Statutory Recommendations-International Commission on Radiological Protection (ICRP) & Pakistan Nuclear Regulatory Authority (PNRA) regulations
- Identify the sources of background radiation and the contribution from each source.
- State the maximum permissible dose equivalent limits to the public and radiation workers.
- Identify the advisory bodies, accrediting organizations, and regulatory organizations for radioactive materials and radiation-generating equipment, and recognize their respective roles.
- Define the principles of time, distance, shielding, and contamination control in radiation protection.
- Define ALARA and its application in radiation protection.
- Identify the methods used to monitor occupational exposure.
- Discuss appropriate equipment used to monitor radiation areas or contamination.
- Comprehend the safety considerations for patients and staff, including pregnant staff.
- Use knowledge of radiation effects in triaging patients during a radiological emergency.
- Discuss the contributions of medical sources to the collective effective dose.
- Define the responsibilities and qualifications of an authorized user (all categories).
- Define the responsibilities and qualifications of a radiation safety officer.
- Explain the types of occupational radiation protection equipment available.
- Comprehend the importance of applying radiation protection principles in clinical protocols.
- Comprehend the best use of gonad shielding and breast shields for patients.

- Describe the requirements for wipe tests & contamination surveys.
- Provide clinical examples that demonstrate ALARA principles.
- Differentiate between controlled and uncontrolled areas.
- Discuss the appropriate written instructions provided to breast-feeding patients receiving a nuclear medicine study.

8. X-Ray Projection Imaging Concepts and Detectors

Fundamental Knowledge:
- The Intensifying screens: construction, physical principles and applications
- The X-ray film: structure and operation, characteristic curve, density, speed, contrast, latitude
- The automatic X-ray film processor, functions, principles, construction, advantages and disadvantages, handling and storage, labeling and identification.
- The Design and care of cassettes, Display and perception of the radiographic image, daylight imaging
- Image intensifiers: construction, operation, brightness gain, optical couplings, TV systems. Recording analogue and digital systems

Objectives:
By the end of two years of training the resident will be able to:
- Describe the fundamental characteristics of all projection imaging systems that determine the capabilities and limitations in producing an x-ray image.
- Describe how variations in the projection imaging system affect the image.
- Review the detector types used to acquire an x-ray image.
- Describe how each detector type influences image quality.
- Describe how radiation is detected by each detector type and the different attributes of each detector for recording information.

9. General Radiography

Objectives:
By the end of two years of training the resident will be able to:

- Describe the components of a radiographic imaging system.
- List the factors affecting radiographic image quality.
- Recognize how the geometric features of a general radiographic system affect the resulting image
- Describe the different types of acquisition systems used in general radiography
- Explain the basic imaging requirements for specific body parts or views acquired in general radiography. The entrance skin exposure and how it relates to patient dose
- Develop appropriate technique factors used in common radiographic procedures.
- Analyze the radiation dose from a medical procedure, and communicate the benefits & risks to the referring physician
- Comprehend the impact of collimation on image processing
- Comprehend the factors determining the appropriate use of grids for different radiographic exams

10. Mammography

Fundamental Knowledge:

- Unique features of mammography tubes and how they affect the x-ray spectrum produced.
- Automatic exposure control (AEC) performance
- Benefits of breast compression
- Magnification techniques
- Characteristics of the different detectors used in digital mammography.
- Breast radiation dosimetry.
- Requirement for facility and physician certification under Mammography Quality Standards Act (MQSA), accreditation, and their effects on image quality and dose.

Objectives:
By the end of two years of training the resident will be able to:

- Describe appropriate uses of the different targets and filters available in mammography systems.
- Recognize image quality changes associated with radiation dose changes (with and without magnification).
- Be familiar with the QA/QC requirements of MQSA for digital mammography
- Comprehend the mechanism of breast tomosynthesis.
- Discuss risk-benefits analysis of mammography with referring physicians and patients.

11. Fluoroscopy and Interventional Imaging

Fundamental Knowledge:

- Basic components of a fluoroscopic system
- How the geometric features of a fluoroscopic system contribute to the resulting image?
- Features of image intensifier (II) systems used for fluoroscopy
- Features of flat-panel detector systems used for fluoroscopy
- Different operating modes used in fluoroscopy imaging
- Components that determine image quality in a fluoroscopy system
- Basic image processing methods used in fluoroscopy, and describe how they are used clinically
- Various clinical applications of fluoroscopic and interventional radiology systems
- Factors that affect patient dose during a fluoroscopic or interventional procedure
- Concepts of exposure and how patient radiation dose is estimated in fluoroscopy and interventional procedures
- Artifacts that can occur with image-intensified and flat-panel fluoroscopy systems
- The PNRA regulations regarding fluoroscopy output rate and potential skin injury

Objectives:
By the end of two years of training the resident will be able to:

- Differentiate among the various image acquisition parameters used in specific clinical applications of fluoroscopy and interventional radiology.
- Describe where the operator should stand to minimize personnel dose when performing an interventional fluoroscopy procedure with the C-arm positioned laterally.
- Describe optimal geometry when positioning patients for fluoroscopy procedure.
- Discuss radiation safety considerations and methods to modify a procedure to minimize the dose for operators.
- Describe the clinical equipment settings which can be implemented to minimize patient peak skin dose in fluoroscopy and interventional radiology.
- Describe how peak skin dose varies from paediatric to bariatric patient sizes.

12. Computerized Tomography (CT)

Fundamental Knowledge:

- Major components of a CT system
- Differences between axial and helical scanning
- Difference between reconstructing and reformatting an image
- How dose modulation affects patient dose?
- Image acquisition parameters, and explain how each affects CT image quality?
- How a CT image is formed?
- Hounsfield unit
- Image characteristics of CT to projection radiography
- Concepts of CT Dose Index (CTDI), Dose-length Product (DLP), and Size-specific Dose Estimate (SSDE)
- Reconstruction kernel selected affects image quality
- Common artifacts, their causes, and methods to minimize them
- Relationship between contrast resolution and radiation dose and the effect of imaging parameters on both
- Over-beaming and over-ranging and how each affects patient dose

- Advantages and disadvantages of iterative reconstruction
- Differences between prospective and retrospective cardiac CT
- Dual-energy CT and its application
- Typical CT numbers for tissues such as air, water, fat, blood, brain, and bone
- Modes of CT operation and their clinical applications
- Retrospective versus prospective CT gating would be used
- How iterative reconstruction affects image quality and the potential implications for acquisition technique?
- Radiation dose to patients and personnel during CT procedures

13. Ultrasound

Fundamental Knowledge:

- Common terms of sound wave propagation and ultrasound interactions with matter
- Basic design of ultrasound transducers, and explain the principles of beam formation
- Different types of array transducers
- Function of commonly used settings on an ultrasound system
- Principle of real-time pulse-echo imaging
- Definitions of axial, lateral, and elevational (along Y-axis) resolution, the factors affecting spatial and temporal resolution, including multiple focal zones
- Common artifacts seen in ultrasound
- Doppler principle and its applications in various Doppler imaging modes
- Aliasing and other Doppler-related artifacts
- Principles of advanced ultrasound technologies, such as harmonic imaging, extended field of view, compound imaging, and 3D/4D ultrasound
- Mechanisms for producing ultrasound bio effects, and describe the significance of the parameters mechanical index and thermal index

Objectives:
By the end of two years of training the resident will be able to:

- Discuss the appropriate use of different type and frequency transducers for clinical applications.
- Describe how to adjust scan parameters to optimize image quality for different clinical applications.
- Describe the advantages and disadvantages of using advanced ultrasound technologies, such as harmonic imaging, extended field of view, compound imaging, and 3D/4D ultrasound.
- Identify common artifacts in ultrasound and their causes.
- Discuss the different modes of Doppler ultrasound and when they can be appropriately used.
- Discuss risks versus benefits of using ultrasound in various clinical areas, especially in obstetrics.

14. Magnetic Resonance Imaging (MRI)

Fundamental Knowledge:

- Properties of magnetism and how materials react to and interact with magnetic fields
- How the magnetic resonance signal is created?
- Magnet designs and typical magnetic field strengths employed for clinical imaging
- Physical properties of a material that determine the MR signal
- Basic pulse sequences used to produce contrast between tissues in MRI
- Components of an MR system and how they are used
- How spatial localization is achieved in MRI?
- Principles of k-space generation and describe how to "fill k-space" to optimize signal strength (signal-to-noise ratio) or acquisition time
- How T1, T2, proton density, and T2* contrast can be achieved in MRI?
- How secondary tissue properties like diffusion, perfusion, and flow can be distinguished in MRI?
- Phase contrast, 2D, and 3D time of flight MRA
- Important concepts of functional MRI

- Types of contrast agents used in MR and how they affect the signal relative to the pulse sequence used
- How image acquisition parameters impact image quality, tissue contrast, and acquisition time?
- Source and appearance of MRI artifacts
- Safety and bio effects of concern in MR systems

Objectives:
By the end of two years of training the resident will be able to:
- Determine how the magnetic properties of a material affect the overall signal obtained in an MR image.
- Identify the most appropriate pulse sequences for a specific diagnostic task.
- Describe contrast-induced nephropathy and methods to reduce risk of such an outcome.
- Describe the risks and benefits when MR imaging is used on a pregnant patient.

- Discuss clinical situations in which MRI procedures are contra-indicated.
- Determine the source of an artifact, and describe a change or changes to the acquisition parameters to reduce the appearance of the artifact.

15. Nuclear Medicine

Fundamental Knowledge:
- Structure of matter, modes of radioactive decay, particle and photon emissions, and interactions of radiation with matter
- Instrumentation, major components, and principles of operation for instruments commonly used for detecting, measuring, and imaging radioactivity
- Instrumentation and software required for image generation and display
- Recommended instrumentation QC tests and test frequencies
- Factors that affect image quality
- Radionuclide production and the principles of radiochemistry

- Common radionuclides and their characteristics, such as energy, half-life, and modes of decay
- Commonly used radiopharmaceuticals, indications for use, and appropriate adult and paediatric dosages
- Radiopharmaceutical QC tests and test frequencies
- Methods of determining organ dose and whole body dose to patients
- Radiopharmaceutical bio-distribution and the impact on radiation dose and risk
- Probability distributions, nuclear counting statistics, and statistics applicable to nuclear imaging
- Methods of image processing, and quality control of image acquisition and processing
- Required radiation protection practices for implementing laboratory tests, diagnostic imaging procedures, and therapeutic applications of radiopharmaceuticals

Objectives:
By the end of two years of training the resident will be able to:
- Compare ideal characteristics of imaging versus therapeutic radiopharmaceuticals.
- Determine the radiopharmaceutical activity administered to adults and paediatric patients for various imaging procedures.
- Describe common nuclear medicine image artifacts, and methods to minimize them.
- Describe the types and uses of common nuclear medicine instrumentation.
- Describe how the selection of image acquisition parameters, including collimator selection, affects image quality.

16. Pharmacology

Fundamental Knowledge:
- Knowledge of the pharmacological agents commonly used in radiological practice including their pharmacology and dosage.
- Preparation of the bowels: purgatives & colonic activators.
- Sedation before radiological procedures.
- Prophylaxis and treatment of reactions to contrast media.

17. Contrast Media

Fundamental Knowledge:
The contrast media to be studied are those which relate to the practical procedures mentioned above.
For each contrast substance the following attributes are expected where relevant:

- Generic name
- Composition
- Modes of administration and clinical uses
- Routes of elimination
- Relative advantages of different types of media
- Side effects and treatment of reactions
- Contraindications to their usage

IMAGING

BREAST IMAGING

Objectives:

At the end of two years of residency, the resident comprehends and is able to describe:

- Anatomy of the female breast, axilla and associated structures and how they change with age (Alteration with age, pregnancy, menstrual cycle and hormonal effects)
- Normal variants and abnormalities of the female breast pathologies
- Difference between normal, benign and malignant disease on mammograms and ultrasound
- Radiographic techniques employed in diagnostic mammography, the principles of digital imaging and image processing pertinent to mammography, including standard cranio-caudal and medio-lateral oblique views, additional views, and tomosynthesis
- Features of dedicated mammography unit including target, filtration, photo timing and grids,
- Assessment of proper positioning, compression, exposure, contrast, sharpness, noise
- Breast compression: Rationale, selection of technical factors, including effects of mAs, KVp and density settings on image quality
- Need for dedicated high resolution monitors and view boxes, view box masking and magnifying glass
- Physics of image production in mammography, particularly how they affect image quality
- Mammographic appearance of artifact such as gridlines, motion unsharpness, noise, dust, poor screen film contact, pickoff and scratches
- Digital (DR), computed radiography (CR) & screen-film mammography differences
- Principles of current practice in breast imaging and breast cancer screening
- The principles and basic application of a standardized diagnostic categorization systems i.e. the ACR Breast Imaging Reporting and Data System (BI-RADS) with reference to mammography, ultrasound, and MRI

- Proper application of other imaging techniques to this specialty (e.g. ultrasound, magnetic resonance imaging and radionuclide radiology) and select cases for other appropriate imaging techniques
- A plan for follow-up protocol for probably benign lesions
- Radiation Protection, International & PNRA Regulations
- Principles of interventional procedures, indications and contraindications, knowledge of equipment, technique of needle localization and stereotactic localization

Reporting Skills
Objectives:
At the end of two years of residency, the resident is able to:
- Read and dictate mammograms of common breast disease under direct supervision of the attending radiologist.
- Participate in mammographic reporting sessions (screening and symptomatic)
- Dictate normal sonographic anatomy, reports of cyst, benign and malignant solid masses
- Participate in the Breast tumor boards and multidisciplinary meetings

Common Clinical Presentations and Diseases
- Breast Lump
- Breast pain
- Nipple inversion
- Nipple discharge
- Paget's disease of the nipple
- Gynecomastia
- Trauma to breast (hematoma, fat necrosis)
- Breast abscesses
- Fibrocystic breast changes
- Fibroadenoma
- Lipoma
- Hamartoma
- Micro and macrocalcifications
- Malignant mass (BIRAD I, II and V)
- Intraductal papillomas

CARDIOVASCULAR SYSTEM
Objectives:
At the end of two years of residency, the resident comprehends and is able to describe:

Anatomy and normal variations:
- Heart and great vessels including lymphatic, normal anatomy and variations of coronary arteries, normal dimensions of the thoracic aorta, peripheral veins and arteries
- Pulmonary arteries - main, right, left, interlobar, Veins, superior and inferior vena cava, azygos and hemiazygos
- Common pathological signs

Techniques in Cardiac Imaging
- The role of ventilation-perfusion scintigraphy in the evaluation of a patient with suspected venous thromboembolic disease, including the advantages and limitations
- Proper application of imaging techniques of Echocardiography, plain x-ray and CT, grey scale and Doppler ultrasound required in diagnosing adult and congenital heart diseases and peripheral vascular diseases

Reporting Skills
Objectives:
At the end of two years of residency, the resident is able to:
- Read and dictate plain x-rays of common cardiac diseases under direct supervision of the attending radiologist
- Read and dictate CT scan of common cardiac diseases under direct supervision of the attending radiologist
- Construct appropriate imaging pathways considering different pathologies

Common Clinical Presentations and Diseases
- Chest Pain
- Shortness of Breath
- Cyanosis
- Syncope
- Chest Trauma

- Claudication
- Hypertension and hypotension
- Leg swelling
- Gangrene
- Aortic aneurysm
- Aortic dissection
- Coarctation of aorta
- Ischemic Heart Disease
- Cardiac Valvular Diseases
- Chamber enlargement of heart on plain x-ray
- Congenital Heart Disease in the Adult: Left-to-right shunts (Atrial septal defect, Ventricular septal defect and Patent ductus arteriosus) TOF
- Heart failure, pulmonary edema
- Eisenmenger physiology
- Pericardial Effusion, calcification in pericarditis
- Enlarged pulmonary arteries on a chest radiograph and distinguish them from enlarged hilar lymph nodes and common causes of pulmonary artery hypertension
- Heart failure

THORACIC RADIOLOGY

Objectives:

At the end of two years of residency, the resident comprehends and is able to describe:

Anatomy and normal variants of the respiratory system:

- Mediastinum and the chest wall on radiographs, CT & MRI
- The lobes of the lungs and fissures, airways, bony cage, paratracheal stripe, junctional lines, aortopulmonary window and paraspinal lines
- Secondary pulmonary lobule, an acinus
- Normal anatomy on the lateral chest radiograph
- Common pathologies on plain x-ray chest, CT scan, HRCT (ask what common pathologies other than ER cases)

Techniques

- The mean exposure doses of chest radiographs and of chest CT examinations
- Techniques to reduce exposure doses of chest radiographs and chest CT examinations
- The principles of digital imaging and image processing pertinent to chest radiology
- The application of radionuclide investigations to chest pathology with particular reference to radionuclide lung scintigrams

Reporting Skills
Objectives:

At the end of two years of residency, the resident is able to:

- Read and dictate chest radiographs (CXR) of common diseases under direct supervision of the attending radiologist.
- Plan the proper acquisition of chest radiographs, ventilation/perfusion imaging, thoracic CT, high-resolution chest CT, and the CT pulmonary angiography (CTPA)
- Recognize and communicate life threatening conditions (pneumothorax, pneumopericardium, flail chest)
- Comprehend and communicate with the patient in order to obtain informed consent prior to diagnostic imaging and interventional procedures of the chest

Common Clinical Presentations:

- Cough
- Shortness of Breath
- Hemoptysis
- Febrile neutropenia
- Hoarseness/stridor
- Chest Trauma
- Fever
- Wheeze
- Trauma

Common Diseases and Signs

- Air bronchogram, Air crescent sign, Deep sulcus sign, Continuous diaphragm sign, Flat waist sign, Gloved finger sign, Hampton's hump, Silhouette sign, Figure 3 sign, Scimitar sign, Double density sign, Hilum overlay sign and hilum convergence sign, migration of fissure and diaphragm (plain x-ray)
- Chest Trauma: widened mediastinum, rib fractures, pneumothorax and pneumomediastinum, pulmonary contusion, laceration and aspiration (plain x-ray, CT)
- Aortic injury on contrast- enhanced chest CT scan
- Consolidation, empyema, pleural effusion, collapse, bronchiectasis, (plain x-ray)
- Asthma
- TB
- Compartment localization of mediastinal masses on CT
- Foreign body
- ARDS

Lines Tubes and Devices

- Endotracheal tube
- Central venous catheter
- Feeding tube
- Nasogastric tube
- Chest tube
- Pacemaker and pacemaker leads
- Pericardial drain

Miscellaneous

- Pulmonary embolism on plain CXR and CT scan and its correlation with nuclear studies
- Identify septal /Kerley A and B lines on a chest radiograph and explain their etiology
- Recognize the changes of congestive heart failure
- Pleural effusion on CXR and CT scan
- Unilateral elevation of the diaphragm on a chest radiograph and suggest a specific etiology like sub diaphragmatic abscess, diaphragm rupture after trauma, and phrenic nerve involvement with lung cancer
- Tension pneumothorax and understand the acute clinical implications

GASTROINTESTINAL (INCLUDING LIVER, PANCREAS AND SPLEEN) (GIT)

Objectives:

At the end of two years of residency, the resident comprehends and is able to describe:

Anatomy and normal variations:

- Salivary glands, abdomen and the main variants including the internal viscera, abdominal organs, omentum, mesentery and peritoneum on conventional radiology, CT, ultrasound and MRI
- Trauma and common pathologies of GIT system

Techniques

- Mean exposure doses of abdominal CT examinations
- Techniques to reduce exposure doses of abdominal radiographs and CT examinations
- Imaging features of abdominal trauma & acute conditions
- Radiological manifestations of disease within the abdomen on conventional radiography, contrast studies, ultrasound
- Applications, contraindications & complications of relevant interventional procedures
- Clinical and radiologic indications for the following studies:
  - Barium swallow
  - Upper GI series
  - Barium enema, single contrast and double contrast
  - Small bowel follow-through
  - Enteroclysis
  - ERCP
  - Fistulogram
- Physiologic properties, concentrations and indications for the use of the following contrast material
  - Barium
  - Water soluble contrast media used in GI radiology
- Pharmacokinetics of glucagon/Buscopan
- Techniques of relevant entergraphy/enteroclysis in cross sectional imaging

Reporting Skills
Objectives:
At the end of two years of residency, the resident is able to:

- Read and dictate plain abdominal x-rays, contrast studies, ultrasound and CT of abdominal diseases under direct supervision of the attending radiologist.
- Recognize proper positioning of abdominal radiographs for adults and explain to the colleagues
- Plan and Protocol an MRI and CT examination of the abdomen according to clinical indication/question
- Obtain informed consent for ultrasound/CT guided interventional procedures

Common Clinical Presentations

- Dysphagia
- Dyspepsia
- Abdominal pain (Acute, Chronic and Acute on chronic)
- Change in Bowel habits, acute and chronic (diarrhea and constipation)
- Vomiting
- Anemia GI bleeding
- Weight loss
- Steatorrhoea
- Jaundice
- Trauma

Common Diseases
Oropharynx:

- Congenital conditions
- Strictures
- Pharyngeal Pouch

Esophagus:

- Strictures
- Reflux
- Trauma
- Inflammatory/infections
- Achalasia
- Vascular rings
- Foreign body

Stomach, Small and Large Bowel:

- Hiatus hernia
- Gastro-esophageal reflux and reflux esophagitis
- Ulcers
- Post-operative stomach
- Small and large bowel obstruction
- Small and large bowel ischemia
- Trauma to bowel
- Appendicitis
- Gallstone ileus
- Pneumoperitoneum (bowel perforation)
- Acute appendicitis and its complications on plain x-ray, ultrasound and CT (FACT)
- Thrombosis or embolism of the superior mesenteric artery
- Intussusception
- Diverticular disease and diverticulitis of colon
- Sigmoid and cecal volvulus
- Ischemic bowel on CT scan
- Paralytic ileus

Pancreas:

- Pancreatitis: Calcifications on plain film and CT scan abdomen and differential diagnosis
- Trauma to pancreas, appearance on CT scan and staging

Liver, Gall Bladder and Spleen:

- Liver abscess
- Portal Hypertension
- Trauma to liver and staging
- Acute and Chronic Cholecystitis
- Cholelithiasis
- Injury to spleen and its staging on CT scan
- Splenic abscess appearance on ultrasound and CT scan

MUSCULOSKELETAL (MSK) INCLUDING TRAUMA
Objectives:
At the end of two years of residency, the resident comprehends and is able to describe:

Anatomy
- Musculoskeletal anatomy and clinical practice relevant to clinical radiology
- Normal variants of normal anatomy, which may mimic trauma

Techniques and Indications
- Routine and specialized views
- Computed tomography
- Magnetic resonance imaging
- Conventional tomography
- Ultrasonography
- Densitometry
- Bone age determination

Variants and Pathologies:
- Sequence of ossification at joints (e.g., elbow)
- Physiologic radiolucency
- Bone island (enostosis)
- Vascular channels
- Chronic infections, Brodie's Abscess
- Sclerosing osteomyelitis
- Rickets and osteomalacia

Reporting Skills
Objectives:
At the end of two years of residency, the resident is able to:
- Read and dictate plain x-rays, ultrasound and CT and MRI of MSK diseases under direct supervision of the attending radiologist.
- Explain and communicate proper positioning of MSK radiographs for adults and children
- Protocol an MRI and CT examination of the MSK according to clinical indication/question
- Obtain informed consent for ultrasound/CT guided interventional procedures in joint effusions and abscesses

Common Clinical Presentations:

- Trauma
- Bone and joint pain
- Fever
- Limping
- Gait problems
- Cord compression symptoms
- Cauda Equina Syndrome
- Bone and joint swelling
- Redness of skin and swelling
- Sciatica

Common Diseases

- Periosteal reaction of infancy
- Spinal dysraphism, meningomyelocele
- Scheuermann disease
- Congenital Anomalies and Dysplasia (Basic)
- Trauma including Salter Harris classification, difference between fractures of ossified and non-ossified skeleton (Greenstick fracture Monteggia fracture/dislocation, Lisfranc fracture/dislocation
- Galeazzi fracture/dislocation
- Complications of fractures: non-healing, mal-alignment, infections
- Infections acute and chronic (Bacterial & Tuberculous acute on chronic infections, Brodie's Abscess, Sclerosing osteomyelitis
- Rickets and osteomalacia
- Hyperparathyroidism/renal osteodystrophy

NEURO-RADIOLOGY / HEAD AND NECK IMAGING INCLUDING ENT/ EYE & DENTAL

Objectives:

At the end of two years of residency, the resident comprehends and is able to describe:

- Anatomy and normal variants on plain radiographs, ultrasound, CT and MRI

Techniques and Indications

- CT and MRI myelography
- The applications, contraindications and complications of invasive neuro-radiological procedures
- The application of ultrasound with particular reference to the thyroid and salivary glands and other neck structures
- The application of radionuclide investigations in particular reference to the thyroid and parathyroid glands
- The vascular anatomy of the central nervous system on a given appropriate film
- The basic principles of CT and MRI physics
- CT and MR imaging protocols
- Trauma, acute CNS and, head and neck pathologies

Reporting Skills

Objectives:

At the end of two years of residency, the resident is able to:

- Read and dictate plain radiographs of skull in trauma and other common Eye/ENT and dental diseases under direct supervision of the attending radiologist.
- Plan acquisition of CT and MRI and CT and MRI angiographic studies in acute conditions
- Recognize and communicate life threatening conditions (intracranial hemorrhage, midline shift, edema brain, uncal and tonsillar herniation)

Common Clinical Presentations and Diseases

- Sensorineural hearing loss, vertigo, tinnitus
- Neck lymphadenopathy
- Trauma
- Headache, vomiting
- Fever
- Altered consciousness
- Nerve palsies
- Jaw locking
- Proptosis
- Salivary gland swelling
- Otalgia
- Trauma
- Otitis Media

- Orbital cellulitis
- Acute sinusitis
- Trauma: Leforte classification, Tripod fracture, Blow-out fractures
- Intracranial hemorrhage (epidural, subdural, intraparenchymal, subarachnoid)
- Cerebral edema
- Uncal and tonsillar herniation
- Brain infarct
- Meningitis
- Hydrocephalus
- Sialadenitis
- Venous sinus thrombosis on CT and MRI
- Retinal and choroidal detachment on ultrasound

OBSTETRICS AND GYNAECOLOGY

Objectives:

At the end of two years of residency, the resident comprehends and is able to describe:

The anatomy and normal variants

- Of the female reproductive organs
- The physiological changes affecting imaging of the female reproductive organs
- The physiological changes of the female reproductive organs during pregnancy
- The fetal anatomy during gestation and the imaging appearances of fetal abnormalities on ultrasound
- The common clinical presentations of acute conditions of obstetrics and gynecology

Techniques and Indications

- The mean exposure doses and the techniques to reduce exposure doses in radiographs, hysterosalpingography and CT examinations of the female reproductive organs
- The principles of imaging acute abdomen in a pregnant lady

Reporting Skills
Objectives:
At the end of two years of residency, the resident is able to:
- Read and dictate radiographs, ultrasound and CT of common diseases of the female reproductive organs under direct supervision of the attending radiologist
- Plan MRI/CT examination of the female reproductive organs and to adapt to the individual situation

Common Clinical Presentations:
- Per-vaginal bleeding in a pregnant female
- Menorrhagia
- Amenorrhea (primary and secondary)
- Dysmenorrhea
- Vaginal discharge
- Anuria
- Lower abdominal pain
- Incontinence of urine
- Dysuria

Common Diseases
Uterus:
- Uterine agenesis, arcuate uterus, unicornuate uterus, uterus didelphys and bicornuate and septate uterus
- Ectopic pregnancy, placenta previa and abruptio placenta
- Threatened, inevitable, incomplete and missed abortion
- Ovarian torsion

Fetus:
- Spina bifida
- Small posterior fossa
- Anencephaly
- Hydronephrosis
- Sacral agenesis
- Absent four chamber view of heart
- Polycystic kidney disease
- Cystic lesions of abdomen
- Hydrops
- Trauma

URO-RADIOLOGY

Objectives:

At the end of two years of residency, the resident comprehends and is able to describe:

The anatomy and normal variants

- Kidneys, ureters, bladder and urethra

Techniques and Indications

- Principles of renal function
- Typical imaging features of renal parenchymal diseases, including infection and renovascular diseases
- Contrast medium management in renal failure
- Typical imaging features and appropriate imaging investigation algorithm of calculus disease
- Imaging features of urinary tract obstruction and reflux
- Proper clinical and radiologic indications for the following studies:
  - IVU
  - Cystogram
  - Voiding cystourethrogram
  - Ultrasonography
- Physiological properties, proper concentrations and proper indications for the use of the contrast material (ionic intravenous contrast media and non-ionic intravenous contrast media)
- High-risk factors for the allergic reactions to intravenous contrast media
- Proper assessment and treatment for allergic reactions to contrast media
- Principles and indications of Doppler ultrasound in kidney diseases (waveform, color, resistive index, pulsatility index and ureteral jets

Pathologies

- Trauma and common emergency presentations of GU system and male reproductive system

Reporting Skills
Objectives:
At the end of two years of residency, the resident is able to:

- Read and dictate radiographs, ultrasound and CT of common diseases of the kidneys, ureters, bladder and urethra under direct supervision of the attending radiologist
- Write imaging algorithms of calculus disease according to the age and gender of the patient

Common Clinical Presentations

- Trauma
- Hematuria
- Lumbar pain
- Loin pain
- Dysuria/nocturia/anuria
- Scrotal pain/mass
- Raised PSA
- Male infertility
- Poor stream
- Retention of urine

Common Diseases

- Nephrolithiasis
- Ureterocele
- Vesicoureteral reflux
- Stress incontinence
- Bladder outlet obstruction
- Neurogenic bladder
- Infertility
- Testicular torsion/ Epididymo-orchitis
- Bladder injury
- Renal injury and grading system
- Pyelonephritis, Renal abscess
- Epispadias and hypospadias
- Posterior valves

PAEDIATRIC RADIOLOGY

Objectives:

At the end of two years of residency, the resident comprehends and is able to describe/recognize:

Normal paediatric anatomy and normal variants:

- Normal anatomy
- Common congenital disorders of the different body regions and their respective relevance for the child´s further development
- Method to establish bone age based on radiographic findings
- Significance of normal maturation and growth

Techniques and Indications:

- Principles of establishing a child-friendly environment
- Relative indications of ultrasound, CT and MRI in children
- Knowledge of increased vulnerability of children to ionizing radiation
- ALARA principle and the special requirements for radiation safety and contrast material dosage in relation to body mass for the paediatric population
- High-risk factors for the allergic reactions to intravenous contrast media in paediatric population
- Proper clinical and radiologic indications in paediatric population for the following studies:
  - IVU
  - Cystogram
  - Voiding cystourethrogram
  - Ultrasonography
  - Upper and lower GI contrast studies
  - Radionuclide studies and PET
  - CT
  - MRI

Common Pathologies:

- Imaging features of common disease entities specific to the paediatric age group

Reporting Skills
Objectives:
At the end of two years of residency, the resident is able to:

- Read and dictate radiographs, ultrasound and CT of common diseases of the paediatric patients under direct supervision of the attending radiologist
- Plan MRI/CT examination in paediatric age group with apporapriate use of sedation/deep sedation and anesthesia and to adapt it to the individual situation

Common Clinical Presentations

- Failure to thrive
- Irritability
- Cough, running nose and fever
- Tachypnea/intercostal recession
- Fever of unknown origin
- Abdominal pain
- Projectile vomiting/bilious vomiting
- Currant jelly stools
- Drooling
- Inability to pass meconium
- Poor urine stream
- Urine infection
- Testicular pain
- Loss of consciousness
- Trauma
- Bone and joint pain

Common Diseases
Chest:
Bronchiolitis, pneumonia, pleural effusion, pneumothorax, foreign body aspiration, thymus and variants, Trauma to chest, aspiration/asphyxia neonatorum

GIT:
Intestinal obstruction, necrotizing enterocolitis, blunt trauma, pneumoperitoneum, gastro-esophageal reflux, hypertrophic pyloric stenosis, malrotation, Hirschsprung's disease, anal imperforation and esophageal atresia

GUT:
Vesico-ureteral reflux and urethral anomalies, imperforate hymen, posterior urethral valves, hydronephrosis, testicular/ ovarian torsion

CNS:
Traumatic brain injury (accidental and non-accidental), congenital disorders of the brain and spine, hypoxic injury to the brain, intracranial hemorrhage

MSK:
Salter Harris fractures, non-accidental injury, osteomyelitis, joint effusion, Legg–Calvé–Perthes disease and slipped capital femoral epiphysis

INTERVENTIONAL RADIOLOGY
Objectives:
At the end of two years of residency, the resident comprehends and is able to describe:

Normal Anatomy and Variant:
- Arterial, venous and lymphatic systems and their relevance to interventional radiology

Techniques and Indications:
- Typical endovascular approaches to common disorders in interventional radiology
- Approaches for image-guided biopsy and placement of drainages
- Risk involved in common interventional techniques
- Use, dosage and administration of local anesthetics
- Pharmacology, administration and patient supervision in relation to intravenous administration of sedation
- Standard procedure in emergency situations, including resuscitation techniques
- Catheterisation techniques and the principles of selective catheterisation and embolisation
- Indications for nephrostomy drainage, abscess drainage and pleural drainage

Reporting Skills
Objectives:
At the end of two years of residency, the resident is able to:
- Read and dictate interventional under direct supervision of the attending radiologist
- Plan the pre workup for interventional examinations
- Plan use of sedation/deep sedation and anesthesia and to adapt it to the individual situation

Common Clinical Conditions and Management Protocols:
- Trauma (preparation of patient for angiographic studies in vessel damage)
- Role of vascular intervention in GI bleeding studies (patient preparation)
- Contrast reaction management
- Vasovagal syncope management
- Pseudo aneurysm management at the site of puncture
- Vascular sheath care
- Ultrasound and CT guided interventional procedures, complications and management

NUCLEAR MEDICINE
Objectives:
At the end of two years of residency, the resident comprehends and is able to describe:
- Relevant aspects of current legislation regarding the administration of radiopharmaceuticals under PNRA
- Technical aspects of radionuclide radiology relevant to optimizing image quality
- Radiopharmaceuticals currently available for the purposes of imaging organs and locating inflammatory collections, tumors and sites of hemorrhage
- Relevant patient preparation, precautions (including drug effects), and complications of the more commonly performed radionuclide investigations
- Strengths and weaknesses of radionuclide investigations to other imaging modalities
- Basic principles of physics including the basic atomic structure, principles of radioactivity and basic of radioactive decay

- Desirable characteristics and physiological clearance of radiopharmaceuticals and PET-tracers
- Principles of biological and effective half-life
- Principles of quantification of PET studies including standardized uptake values (SUV)
- Basic physical principles of nuclear medicine imaging technology, including gamma cameras, single photon emission computed tomography (SPECT), and positron emission tomography (PET)
- Basic physical principles of hybrid imaging, including PET-CT, SPECT-CT and MR-PET
- Safety aspects in nuclear medicine and hybrid imaging, including patient dosimetry, staff dosimetry, contamination, monitoring, choice of equipment, quality control and safety/risk management

Reporting Skills
Objectives:
At the end of two years of residency, the resident is able to:
- Identify urgent and/or unexpected findings in nuclear medicine and hybrid imaging examinations and to communicate these timely and properly
- Apply the appropriateness criteria (reference RCR and European/ACR) and indications for nuclear medicine and hybrid imaging procedures under guidance of nuclear medicine specialists

Common Clinical Conditions and their Interpretation:
- Bone metastasis/metabolic bone disease, osteomyelitis, primary bone tumors
- Function of kidneys, PUJ obstruction, vesico-ureteric reflux, cortical scarring
- CNS (cerebral metabolism and perfusion studies)
- Endocrine (adrenal, thyroid & parathyroid uptake studies)
- GIT (GI transit studies, GI bleeding, Meckel's diverticulum, Hepatobiliary studies)
- Infections and Inflammation (basic mechanism of infection and occult sepsis)
- Lymphoscintigraphy (sentinel node localization and knowledge of spread of cancer)

- Respiratory System (Pulmonary embolism studies, Ventilation perfusion studies)
- CVS (Myocardial perfusion studies)
- Paediatrics (Use of radionuclide in paediatric population and understanding of growing skeleton)

HEALTH INFORMATICS

Objectives:

The trainee will be able to:

- Develop core skills in information technology, especially the ability to perform basic word-processing, and to access computerized medical databases, electronic mail systems and the internet
- Keep abreast of developments in information management relevant to radiology department

TECHNICAL COMPETENCIES

The resident must demonstrate assessment, diagnostic and basic technical skills for effective patient care at minimum levels of competencies identified.

Key for Assessing Competencies:

1. Observer Status.
2. Assistant Status.
3. Performed Under Direct Supervision.
4. Performed Under Indirect Supervision.

COMPETENCIES	FIRST YEAR								TOTAL # OF CASES
	3 MONTHS		6 MONTHS		9 MONTHS		12 MONTHS		
	Level	Cases	Level	Cases	Level	Cases	Level	Cases	
REPORTING									
GENERAL X-RAY REPORTING	1 2	25 25	2	40	2	50	2 3	40 40	220
ULTRASOUND OF ABDOMEN	1 2	15 15	2	30	2 3	20 20	2 3	25 25	150
ULTRASOUND, PELVIS AND OBSTETRICS & GYNAECOLOGY	1 2	15 15	2	30	2 3	20 20	2 3	25 25	150
DOPPLER ULTRASOUND	1	10	2	15	2	15	2	10	50
CT AND ULTRASOUND, GUIDED PROCEDURES	1	2	1 2	3 3	2	3	2	4	15
CT SCAN									
• HEAD AND NECK	1	5	1	10	2	10	2	15	40
• CHEST ABDOMEN AND PELVIS	1	5	1	10	2	10	2	15	40
• MSK	1	5	1	7	2	8	2	10	30
• CTA	1	2	1	3	2	2	2	3	10
MAMMOGRAPHY	1	5	2	5	2	10	2 3	10 10	40
C.T. FLUOROSCOPY	1	3	1	3	2	4	2 3	3 3	16

COMPETENCIES	FIRST YEAR								TOTAL # OF CASES
	3 MONTHS		6 MONTHS		9 MONTHS		12 MONTHS		
	Level	Cases	Level	Cases	Level	Cases	Level	Cases	
REPORTING									
MISCELLANEOUS	1	2	1	2	2	3	2 3	1 1	9
RETROGRADE URETHROGRAM,MCUG, FISTULA	1	3	1	3	2	4	2 3	3 3	16
MRI • BRAIN AND SPINE	1	3	1	4	1	4	1 2	2 2	15
• ABDOMINAL AND PELVIS	1	2	1	2	1	2	1 2	1 1	8
• MSK	1	2	1	2	1	2	1 2	1 1	8

COMPETENCIES	SECOND YEAR								TOTAL # OF CASES
	15 MONTHS		18 MONTHS		21 MONTHS		24 MONTHS		
	Level	Cases	Level	Cases	Level	Cases	Level	Cases	
REPORTING									
GENERAL X-RAY REPORTING	3	40	3	40	3	50	3	80	210
ULTRASOUND OF ABDOMEN	3	30	3	30	3	40	3	50	150
ULTRASOUND, PELVIS AND OBSTETRICS & GYNAECOLOGY	3	30	3	30	3	40	3	50	150
DOPPLER ULTRASOUND	3	20	3	20	3	30	3	30	100
CT- AND ULTRASOUND- GUIDED PROCEDURES	3	4	3	5	3	6	3	10	25
CT SCAN									
• HEAD AND NECK	2	10	2	10	2	20	2	20	60
• CHEST ABDOMEN ABD AND PELVIS	2	10	2	10	2	20	2	15	55
• MSK	2	5	2	5	2	20	2	10	40
• CTA	2	2	2	2	2	2	2	2	8
MAMMOGRAPHY	3	10	3	10	3	10	3	10	40
C.T. FLUOROSCOPY	3	2	3	2	3	3	3	3	10
MISCELLANEOUS RETROGRADE URETHROGRAM,MCUG, FISTULA	3	5	3	5	3	5	3	5	20
MRI									
• BRAIN AND SPINE	2	4	2	4	2	4	2	3	15
• ABDOMINAL AND PELVIS	2	3	2	3	2	2	2	2	10
• MSK	2	3	2	3	2	2	2	2	10

INTRA-DEPARTMENTAL ROTATIONS

ABOVE COMPETENCIES CAN BE ACQUIRED THROUGH INTRA-DEPARTMENTAL ROTATIONS AS FOLLOWS:

	R-1	R-2
IVP+FLURO	1 MONTH	1 MONTH
ULTRASOUND	2 MONTHS	3 MONTHS
CT	2 MONTHS	2 MONTHS
MRI	1 MONTH	1 MONTH
GENERAL REPORTING/ER	2 MONTHS	1 MONTH
WOMEN IMAGING/BREAST	1 MONTH	1 MONTH
PAEDS (IF CENTER DOES NOT HAVE DEDICATED PAEDS ROTATION, THEN ADJUST THESE TWO MONTHS IN US, CT, AND MRI IN RESPECTIVE YEARS)	1 MONTH	1 MONTH
VASCULAR AND INTERVENTIONAL RADIOLOGY (DSA)	-	1 MONTH
ELECTIVE ROTATION ON DISCRETION OF DEPARTMENT ACCORDING TO RESIDENT'S NEED	1 MONTH	-

NUCLEAR MEDICINE (4 WEEKS)	LEVEL	CASES
REPORTING		
BASE SCAN RENAL SCAN THYROID PET SCAN		LEVEL 1 AND 2 TOTAL CASES 30 ANYTIME IN 2 YEARS TRAINING

ASSESSMENT

FORMATIVE ASSESSMENT

College of Physicians and Surgeons Pakistan, in order to implement competency-based education in letter and spirit, is introducing Work Placed Based Assessment (WPBA) in addition to institutional/ departmental assessments. To begin with college is introducing Mini-CEX / Mini-IPX and DOPS to ensure that the graduates are fully equipped with the clinical competencies.

Mini-Imaging Interpretation Exercise (MINI-IPX)

During training in Diagnostic Radiology, at least one Mini-IPX in each quarter is to be conducted as per the earmarked topics given below:

- Mini-IPX is intended to assess a resident's skills in interpreting an imaging study & to provide rapid & prompt feedback to the resident about her/his diagnostic skills.
- Mini-IPX is entirely a formative tool of assessment and is to be accompanied with constructive feedback.
- Each Mini-IPX encounter extends for about 20 minutes with 05 minutes for feedback and further action plan.
- The trainee should initiate the process by identifying the imaging study to be assessed (like CT chest and abdomen).
- It is mandatory that resident already has the experience of reporting similar cases under supervision.
- Where the mini-IPX involves patient interaction, it is to be ensured that the patient is aware that the mini-IPX is being carried out, like in ultrasound.
- An Assessor will directly observe the Resident performing the activity and then rate the performance on the attributes outlined in the assessment form keeping the resident's expected training level in consideration.
- Feedback will be provided to the resident immediately after the assessment including specific written comments on areas of good practice and constructive feedback on areas for further development. The resident will be encouraged to provide comments on his/her performance and what actions he/she plans for further improvement.

- In case of unsatisfactory performance of the resident, a remedial has to be completed within stipulated time frame
- Non-compliance by the resident has to be reported in quarterly feedback.
- The performance is reported online on the prescribed form (sample given below)

LIST OF TOPICS FOR MINI-IPX:

YEAR-1

QUARTER-1
- X-ray Chest

QUARTER-2
- X-ray MSK

QUARTER-3
- X-ray Abdomen/Kub

QUARTER-4
- Screening Mammogram

YEAR-2

QUARTER-1
- CT Head for Stroke / Bleed

QUARTER-2
- X-ray Chest (ICU & Post-OP)

QUARTER-3
- Paeds Chest & Abdomen

QUARTER-4
- MRI Brain for ER-based cases

MINI-IMAGING INTERPRETATION EXERCISE (MINI-IPX)

FCPS DIAGNOSTIC RADIOLOGY
Time Duration = 20 mins (15 mins assessment and 5 mins feedback)

PLEASE COMPLETE THE QUESTIONNAIRE BY FILLING/CHECKING APPROPRIATE BOXES

Assessor: _____ Assessment Date: _____

Resident's Name: _____

Hospital Name: _____ RTMC Number: _____

Specialty: _____

Years of Residency: ☐ R1 ☐ R2 ☐ R3 ☐ R4

Quarter: ☐ 1st ☐ 2nd ☐ 3rd ☐ 4th

Modality: ☐ Plain Film ☐ Fluoroscopy ☐ Ultrasound ☐ CT ☐ MRI
☐ Interventional Radiology ☐ Radionuclide Imaging/PET CT

System: ☐ Neuro/ENT ☐ Thoracic (CV/Resp) ☐ GI/HPB ☐ Genito-urinary
☐ Musculoskeletal ☐ Obstetrics/Gynecology/Breast

Complexity of Case/ Procedure: ☐ Low/Easy ☐ Moderate/Average ☐ High/Difficult
☐ N/A

Number of times procedure performed by resident: (approximately) _____

PLEASE GRADE THE FOLLOWING AREAS ON GIVEN SCALE:	NOT OBSERVED / APPLICABLE	BELOW EXPECTATIONS		SATISFACTORY	ABOVE EXPECTATIONS	EXCELLENT
		1	2	3	4	5
WHEN GIVEN, IS THE CLINICAL QUESTION WRITTEN?						
UNDERSTANDING OF RELEVANT ANATOMY						
APPROPRIATE REFERENCE TO PREVIOUS INVESTIGATIONS						
OBSERVATION OF FINDINGS IMAGE INTERPRETATION						
CONCLUSION / D/D (DOES THE REPORT ANSWER THE CLINICAL QUESTION?)						
FURTHER RECOMMENDATION GIVEN						
OVERALL CLINICAL JUDGEMENT						

Assessor's Satisfaction with Mini-IPX:

(Low) 1 2 3 4 5 (high)

Resident's Satisfaction with Mini-IPX:

(Low) 1 2 3 4 5 (high)

Strengths	Suggestions for Improvement

Encounter to be repeated: ☐ **YES** ☐ **NO**

Signature: _____

Direct Observation of Procedural Skills (DOPS)

During training in Diagnostic Radiology, at least one DOPS in each quarter is to be conducted as per the earmarked topics/ procedures given below:

- DOPS is entirely a formative tool of assessment and is to be accompanied with constructive feedback.
- Each DOPS encounter extends for about 20 minutes with 05 minutes for feedback and further action plan.
- The trainee should initiate the process by identifying the procedure to be assessed.
- Every procedure needs to be observed/assisted/performed under supervision at least once before the assessment can take place. Number of assisted procedures are mandatory to be mentioned on the assessment form.
- Prior to the start of a procedure being assessed, the form needs to be discussed between the assessor and the resident.
- An assessor will directly observe the resident undertaking a procedure and then rate his/her performance on the prescribed DOPS form.
- Feedback will be provided to the resident immediately after the assessment including specific written comments on areas of good practice and constructive feedback on areas for further development. The resident will be encouraged to provide comments on his/her performance and what actions he/she plans for further improvement.
- In case of unsatisfactory performance of the resident, a remedial has to be completed within stipulated time frame.
- Non-compliance by the resident has to be reported in quarterly feedback.
- The performance is reported online on the prescribed form (sample given below):

LIST OF TOPICS FOR DOPS:

YEAR-1

QUARTER-1

- Ultrasound Bladder

QUARTER-2

- Ultrasound Liver, Gall Bladder

QUARTER-3

- FAST (Ultrasound)

QUARTER-4

- Ultrasound Obstetrics, Gynaecology including dating of pregnancy

YEAR-2

QUARTER-1

- Ultrasound Whole Abdomen

QUARTER-2

- Ultrasound guided Ascitic tap / Pleural tap (Diagnostic)

QUARTER-3

- Doppler Legs DVT

QUARTER-4

- Fluoroscopy (any procedure)

OBSERVATION OF PROCEDURAL SKILLS (DOPS)

FCPS DIAGNOSTIC RADIOLOGY
Time Duration = 20 mins (15 mins assessment and 5 mins feedback)

PLEASE COMPLETE THE QUESTIONNAIRE BY FILLING/CHECKING APPROPRIATE BOXES

Assessor: _____ Assessment Date: _____

Resident's Name: _____

Hospital Name: _____ RTMC Number: _____

Specialty: _____

Years of Residency: ☐ R1 ☐ R2 ☐ R3 ☐ R4

Quarter: ☐ 1st ☐ 2nd ☐ 3rd ☐ 4th

Setting: ☐ O.T. ☐ Procedure Room ☐ Other: _____

Diagnosis of Patient: _____ Patient Age: Sex: _____

Complexity of Case/ Procedure: ☐ Low/Easy ☐ Moderate/Average ☐ High/Difficult ☐ N/A

Number of times procedure performed by resident: _____

PLEASE GRADE THE FOLLOWING AREAS ON GIVEN SCALE:	NOT OBSERVED / APPLICABLE	BELOW EXPECTATIONS		SATISFACTORY	ABOVE EXPECTATIONS	EXCELLENT
		1	2	3	4	5
INDICATIONS, ANATOMY AND STEPS OF PROCEDURE						
INFORMED CONSENT, WITH EXPLANATION OF PROCEDURE AND COMPLICATIONS						
PREPARATION FOR PROCEDURE ACCORDING TO ACCEPTED PROTOCOL						
USE OF LOCAL ANALGESIA OR SEDATION						
OBSERVANCE OF ASEPSIS						
SAFE USE OF INSTRUMENTS / MACHINES						
USE OF ACCEPTED TECHNIQUES						
MANAGEMENT OF UNEXPECTED EVENT (OR SEEKS HELP)						
POST-PROCEDURE INSTRUCTIONS TO PATIENT AND STAFF						
APPLICATION OF RADIATION PROTECTION PRINCIPLES						
PROFESSIONALISM						
OVERALL ABILITY TO PERFORM WHOLE PROCEDURE						

Assessor's Satisfaction with DOPS:

(Low) 1 2 3 4 5 (high)

Resident's Satisfaction with DOPS:

(Low) 1 2 3 4 5 (high)

Strengths	Suggestions for Improvement

Encounter to be repeated: ☐ YES ☐ NO

Signature: _____

SUMMATIVE ASSESSMENT

Eligibility requirements for appearing in Intermediate Module examination a candidate should have:

- Passed FCPS-I in Diagnostic Radiology or granted exemption by CPSP
- Completed two years of RTMC Registered training under an approved supervisor in an institution recognized by the CPSP. A certificate of completion of training must be submitted
- Completion of entries in e-logbook along with validation by the supervisor
- Completed CPSP mandated Mini-IPX & DOPS in e-logbook
- Submitted certificates of attendance of mandatory workshops
- Submitted synopsis for one research paper

EXAMINATION SCHEDULE

- The Intermediate Module theory examination will be held twice a year
- Theory examinations are held in various cities of the country usually at Abbottabad, Bahawalpur, Faisalabad, Hyderabad, Islamabad, Karachi, Lahore, Larkana, Nawabshah, Multan, Peshawar, Quetta and Rawalpindi centers. The College shall decide where to hold TOACS examination depending upon the number of candidates in a city and shall inform the candidates accordingly
- English is the medium of all examinations i.e. theory & TOACS
- The College will notify of any change in the centers, the dates and format of the examination
- A competent authority appointed by the College has the power to debar any candidate from any examination if it is satisfied that such a candidate is not a suitable person to take the College examination because of using unfair means in the examination, misconduct or other disciplinary reasons

EXAMINATION FEE

- Applications along with the prescribed examination fee and required documents must be submitted by the last date notified for this purpose before each examination.
- The details of examination fee and fee for change of center, subject, etc. shall be notified before each examination.
- Fee deposited for a particular examination shall not be carried over to the next examination in case of withdrawal, absence or exclusion

REFUND OF FEES

If after submitting an application for examination, a candidate decides not to appear, a written request for a refund must be submitted before the last date for withdrawal with the receipt of applications. In such cases a refund is admissible to the extent of 75% of fees only. No request for refund will be accepted after the closing date for receipt of applications for refund.

If an application is rejected by the CPSP, 75% of the examination fee will be refunded, the remaining 25% being retained as a processing charge. No refund will be made for fees paid for any other reason, e.g. late fee, change of centre/subject fee, etc.

FORMAT OF EXAMINATION

Intermediate Module examination consists of the following components:

Theory Examination:

Theory Examination consists of:

Paper-I: 100 Single Best Type of MCQs covering Emergency and conventional radiology

Paper-II: 100 Single Best Type of MCQs covering Radiological Physics, Radiological Pharmacology, techniques and protocols, radiological procedures and anatomy

Only those candidates who qualify in the theory will be eligible to take the TOACS examination.

Clinical Examination:
The clinical examination consists of TOACS.

TOACS
This comprises of 20 stations, each of 6 (2+4) minutes duration. At each station two images/ digital films (A & B) are presented, and the students are required to give written response to the questions asked with each film.

Film A is accompanied with questions/tasks about radiological anatomy, physics, radiation protection, contrast/pharmacology, radiological techniques and equipment. Film B will have clinical /radiological questions / tasks about common and emergency related conditions, as delineated in syllabus.

POST IMM (FCPS-II)
DIAGNOSTIC RADIOLOGY

ROTATION

- Vascular and Interventional Radiology: **4 weeks**

OBJECTIVES

The advance phase (FCPS-II) of fellowship programme in Diagnostic Radiology is the continuation of training in the same direction as was determined by the objectives listed at the beginning of fellowship programme, except that the residents will be required to apply knowledge of basic sciences including physics and many radiological competencies acquired during IMM training to accomplish more complex tasks and functions included in DGR practice.

The specific outcomes included in various areas of this practice are given in greater detail under syllabus.

SYLLABUS

BREAST

Objectives:

At the end of residency programme, the resident comprehends and is able to describe:

Essential Knowledge and Critical Thinking

- Radiological manifestation of disease in the breast on mammography, digital breast tomosynthesis, ultrasound & MRI
- Assessment of breast implants on mammograms, ultrasounds, and MRIs
- Principles of current practice in breast imaging and breast cancer screening
- Principles and basic application of a standardized diagnostic categorization systems i.e. the ACR Breast Imaging Reporting and Data System (BI-RADS®) with reference to mammography, ultrasound, and MRI

Reporting Skills

- Read and dictate mammograms and sonograms of common breast diseases under direct supervision of the attending radiologist
- Read and dictate MRI breasts under direct supervision
- Participate in mammographic reporting sessions (screening and symptomatic)

Common Clinical Presentations and Diseases

Following is a broad enumeration of common clinical presentation and diseases to create a framework of knowledge, however, there is no real limit. All radiological applications related to breast may be assessed.

- Breast Lump
- Breast pain
- Nipple inversion
- Nipple discharge
- Paget's disease of the nipple
- Gynecomastia
- Breast implant

- Micro calcification
- Breast lump
- Architectural distortion
- Benign Diseases
- Fibroadenoma, Lipoma, Hamartoma, papilloma, cyst, radial scar, complex sclerosing lesion, benign micro-calcification, Gynecomastia, Cystosarcoma phylloides
- Malignant Diseases
- Tumor-in-situ, invasive and metastatic disease
- Indeterminate Diseases
- Atypical ductal hyperplasia, , lobular carcinoma in situ, ductal carcinoma in situ
- Outcome of screening
- Staging of breast cancer
- Trauma
- Fat necrosis, hematoma, abscess

CARDIOVASCULAR SYSTEM

Objectives:

At the end of residency programme, the resident comprehends and is able to:

Essential Knowledge and Critical Thinking

- Describe application of the following techniques:
    - Echocardiography (including transesophageal)
    - Nuclear Medicine investigations of the heart
    - Magnetic resonance imaging
    - Angiography
    - CT angiography of coronary and peripheral vessels
    - Heart transplant and its complications

Reporting Skills

- Report plain x-rays, CT, and MRI of common cardiac diseases under direct supervision of the attending radiologist
- Construct appropriate imaging pathways considering different pathologies

Common Clinical Presentations and Diseases

Following is a broad enumeration of common clinical presentation and diseases to create a framework of knowledge, however, there is no real limit. All radiological applications related to cardiovascular system may be assessed.

- Chest Pain
- Shortness of Breath
- Cyanosis
- Syncope
- Chest Trauma
- Claudication
- Hypertension and hypotension
- Leg swelling
- Gangrene
- Stroke
- Pericarditis
- Acquired Cardiac Diseases
- Valvular Diseases
- Congenital Cardiac Diseases
- Tetralogy of Fallot, Asplenia, Polysplenia syndromes, atrial septal defect, ventricular septal defect, Patent ductus arteriosus, transposition of great arteries, anomalous pulmonary venous drainage, arch abnormalities (Rings and Slings)
- Complications of Medical and Surgical Procedures
- Stent and grafts on MDCT, Valve prosthesis and intra-cardiac devices
- Heart failure, pulmonary edema, Eisenmenger physiology
- Major vessel disease
- Marfan syndrome, Takayasu's disease, Aortic aneurysm, Aortic dissection, Coarctation of aorta
- Coronary artery disease
- Myocardial infarction, ventricular aneurysm, coronary artery aneurysm, Dressler syndrome
- Myocardial Diseases
- Acute myocarditis, obstructive and restrictive myocarditis, Pericardial Effusion, calcification in pericarditis
- Cardiac tumors
- Myxoma, Rhabdomyoma, sarcoma, Hemangioma

- Enlarged pulmonary arteries on a chest radiograph and distinguish them from enlarged hilar lymph nodes and common causes of pulmonary artery hypertension
- Chamber enlargement of heart on plain x-ray
- Blunt cardiac injury
- Contusion of myocardial muscle, rupture of a cardiac chamber, or disruption of a heart valve

THORACIC RADIOLOGY

Objectives:

At the end of residency programme, the resident comprehends and is able to:

Essential Knowledge and Critical Thinking

- Describe:
  - Tree-in-bud, air trapping, cysts, and ground glass opacities, mosaic pattern, crazy paving appearance on HRCT
  - Mean exposure doses of chest radiographs and of chest CT examinations
  - Techniques to reduce exposure doses of chest radiographs and of chest CT examinations
  - Principles of digital imaging and image processing pertinent to chest radiology
  - Features on radiographs and CT and the differential diagnosis of diffuse interstitial and alveolar lung disease, airways, and obstructive lung disease
  - Imaging protocol of solitary pulmonary nodule and the international Lung cancer screening guidelines
  - Reporting system in screening for lung cancer, the "Lung RADS™ Version"
  - Imaging protocol of pulmonary embolism
  - Indications of PET/CT and other nuclear medicine techniques (e.g., V/Q scintigraphy, SPECT)

Reporting Skills

- Construct a concise, informative radiology report in chest x-rays with, where appropriate, recommendations for further radiological tests under indirect supervision of the attending radiologist
- Report CT chest under direct and indirect supervision
- Report MRI chest under direct supervision

Common Clinical Presentations

Following is a broad enumeration of common clinical presentation and diseases to create a framework of knowledge, however, there is no real limit. All radiological applications related to respiratory system may be assessed.

- Cough
- Shortness of Breath
- Hemoptysis
- Febrile neutropenia
- Recurrent infections or infections 'unresponsive' to treatment
- Hoarseness/stridor
- Chest Trauma
- Fever
- Wheeze
- Incidental finding on chest x-rat and CT scan
- Trauma
- Erythema Nodosum

Common Diseases

Trachea and Airway Diseases:

- Tracheal stenosis, Tracheo-bronchomalacia, Tracheal tumors, atelectasis, Obstructive Lung Disease, Respiratory bronchiolitis (RB), respiratory bronchiolitis-associated interstitial lung disease (RB-ILD)
- COPD, bronchiolitis obliterans and bronchiectasis
- Emphysema (Centrilobular, Paraseptal, Panacinar/ panlobular)

Lungs:
Diffuse Parenchymal Diseases:

- Sarcoidosis, Hypersensitivity pneumonitis, Cystic lung diseases (Langerhans' cell histiocytosis, tuberous sclerosis / lymphangioleiomyomatosis, Amyloidosis, Alveolar proteinosis, Alveolar microlithiasis, Eosinophilic pneumonias, Vasculitides, Pulmonary hemorrhage syndromes

Drug-Induced Disease:
Infections:

- Lobar/broncho pneumonias, primary pulmonary Aspergillus disease, Primary, secondary and Miliary Tuberculosis, Histoplasmosis, Pneumocystis carinii pneumonia
- Idiopathic interstitial pneumonias
- Usual Interstitial Pneumonitis/ Idiopathic pulmonary fibrosis
- Nonspecific interstitial pneumonia
- Cryptogenic organizing pneumonia

Tumors:

- Mediastinal Masses and Mediastinal / Hilar Lymph Node Enlargement
- Squamous cell (or epidermoid) carcinoma,
- Adenocarcinoma (including alveolar cell carcinoma) New classification of adenocarcinomas (incl. atypical adenomatous hyperplasia, adenocarcinoma in situ, minimally invasive adenocarcinoma, invasive adenocarcinoma
- Large cell undifferentiated
- Small (oat) cell carcinoma and pulmonary metastasis
- Lymphangitic Carcinomatosis
- Lymphoma (Hodgkin's and non-Hodgkin)
- Hamartoma
- Tracheal carcinoma
- Thymic tumors
- Thyroid neoplasms
- Mediastinal germ cell tumors
- Foregut duplication cysts

- Neurogenic tumors
- Mediastinal sarcomas

Pleura:
- Effusion and empyema, Benign diffuse pleural thickening, Pleural calcification / pleural plaques, Pneumothorax / hydropneumothorax, Bronchopleural fistula, Pleural fibroma, lipoma, malignant pleural mesothelioma, secondary pleural malignancy, Pleuro-parenchymal fibroelastosis

Occupational Diseases:
- Silicosis / Coal worker pneumoconiosis, Asbestosis
- Postoperative chest and its complications

Intensive Care Chest:
- Plain x-rays, CT scans and ultrasounds of critically ill patient and / or the patient after major traumatic injury, Barotrauma/pneumothoraces
- Fat embolism associated with long bone fractures
- Pulmonary oedema (cardiogenic, non-cardiogenic / ARDS)
- Position of lines/tubes/catheter and other devices, and complications of misplacement

Radiation Injury to the Lung:
- Lung Transplant and its Complications

GASTROINTESTINAL INCLUDING LIVER, PANCREAS AND SPLEEN

Objectives:

At the end of residency programme, the resident comprehends and is able to:

Essential knowledge and Critical Thinking:
- Describe:
  - Indications and contraindications for various imaging examinations in abdominal diseases
  - Radiation burden and risks of different investigations in abdominal imaging

- Radiological manifestations of disease within the abdomen on conventional radiography, contrast studies, ultrasound, CT, and MRI
- Applications, contraindications, and complications of relevant interventional procedures
- MRI and CT techniques of enterography & enteroclysis
- Technique of PET-CT
- Rationale, technique, principle, and results of therapeutic embolisation and trans arterial chemoembolization
- Role of Nuclear Medicine and CT angiography imaging in GI bleeding
- Interventional procedures in portal hypertension
- Major techniques and the indications for treatment (surgical resection, chemo- or radioembolization, percutaneous ablation, liver transplantation, oral targeted therapy)
- Principles and methods for fibrosis quantification using ultrasound and MRI
- Imaging appearance and the different methods for quantification of liver iron overload
- Imaging features of cholangiocarcinoma of the liver hilum (Klatskin's tumour) and the tumour staging, with regard to treatment options (resectability, indication for palliation) the imaging features of a pancreatic pseudocyst and to discuss the advantages and limitations of different treatments (follow-up, interventional procedure, percutaneous or endoscopic surgery)

Reporting Skills

- Report plain abdominal x-rays under indirect supervision
- Report contrast studies, ultrasound, CT, and MRI of abdominal diseases under direct supervision of the attending radiologist

Common Clinical Presentations

Following is a broad enumeration of common clinical presentation and diseases to create a framework of knowledge, however, there is no real limit. All radiological applications related to gastrointestinal system may be assessed.

- Dysphagia
- Dyspepsia
- Abdominal pain (Acute, Chronic, Acute on chronic)
- Change in Bowel habits (acute and chronic, Diarrhea or Constipation)
- Vomiting
- Anemia GI bleeding
- Weight loss
- Steatorrhea
- Jaundice
- Trauma

Common Diseases

Salivary Glands:

- Inflammatory, stone diseases and tumors, of salivary glands, appearance and diagnosis on contrast studies, ultrasound, CT and MRI

Esophagus:

- Motility disorders, oesophagitis, achalasia, hital and diaphragmatic hernia, iatrogenic and ingestion injuries, Benign peptic strictures, varices, extrinsic compressions, benign and malignant tumors of esophagus

Stomach and Duodenum:

- Gastritis, duodenitis and peptic ulcer disease on upper GI contrast studies
- Zollinger-Ellison syndrome,
- Benign and malignant tumors and staging & linitis plastica
- Gastric volvulus, para-duodenal hernias, superior mesenteric artery syndrome, gastric and duodenal diverticulum
- Gastric surgery and its early and late complications
- Surgical procedures for the treatment of obesity and the normal postoperative radiological appearance and imaging features of complications

- Rotational abnormalities of the duodenum and the appearance of annular pancreas
- Sub mucosal tumors, ampullary tumors and staging

Small Bowel:
- Small bowel obstruction on plain film, CT and MRI
- Crohn's disease, polyposis syndromes, Whipple's disease,
- Infectious and non-infectious enteritis
- Malabsorption syndromes
- Malrotation and volvulus of the small bowel
- Peritoneal pathologies
- Benign and malignant tumors, stromal tumor, lymphoma, carcinoid tumor, adenocarcinoma
- Amyloidosis, radiation-induced injury, Meckel's diverticulum, coeliac disease, diverticulosis and systemic sclerosis

Large Bowel:
- Colorectal polyps and corresponding polyposis syndromes
- Colorectal cancer, its staging, recurrence
- Crohn's, ulcerative and ischaemic colitis, Irritable bowel syndrome
- Rectum and presacral space pathologies, perianal fistulas, rectal tumours according to the tumour proximity with the mesorectal fascia, distance to the sphincter and to describe the potential limitations of MRI for lymph node staging
- Anal sphincter tears and perianal sepsis

Acute Abdomen:
- Collections, perforated bowel and post-surgical complications

Peritoneal Disease:
- Nodules, thickening, fluid collection
- mesenteric cysts, rectus sheath hematoma
- Peritonitis, peritoneal Carcinomatosis, peritoneal tuberculosis, mesenteric lymphoma, mesenteric and greater omental infarction

Liver:

- Cirrhosis, Portal Hypertension, atrophy or hypertrophy of liver, regeneration nodules, fibrosis
- Hepatocellular carcinoma staging and treatment options, metastasis
- Vascular diseases of the liver, including Budd–Chiari Syndrome, Osler–Weber disease, portal thrombosis, peliosis and sinusoidal obstruction syndrome
- Typical and complicated hydatid cysts
- Amoebic abscess and pyogenic abscess of the liver
- Liver Hemangioma, typical and atypical focal nodular hyperplasia and
- Liver cell adenoma
- Homogeneous and heterogeneous liver steatosis
- Liver transplant

Bile Ducts and Gallbladder:

- Acute and chronic, gangrenous, emphysematous and acalculous Cholecystitis
- Adenomyomatosis
- Adenocarcinoma of the gallbladder, Klatskin's tumor
- Primary sclerosing cholangitis
- Benign biliary strictures
- Cholangiocarcinoma

Pancreas:

- Acute and chronic pancreatitis
- Pancreatic adenocarcinoma and staging and criteria for unresectability
- Cystic tumors of the pancreas, (serous and mucinous cystadenoma, intraductal mucinous tumors and rare cystic tumors)

Spleen:

- Lymph proliferative disorders, focal lesion
- Focal splenic abnormalities due to infections
- Benign and malignant masses
- Splenic calcification, causes of splenic enlargement

NEURO-RADIOLOGY

Head and Neck Imaging Including ENT / Eye and Dental

Objectives:

At the end of residency programme, the resident comprehends and is able to:

Essential Knowledge and Critical Thinking

- Describe:
  - Rationale for selecting appropriate imaging techniques diseases of central and peripheral nervous system
  - Rationale of using IV contrast in diagnosing diseases of the central and peripheral nervous system
  - Imaging features of stroke, hemorrhage and other common vascular lesions of the brain and spinal cord
  - Imaging features of traumatic brain injury and spinal trauma and its neurological consequence
  - Imaging features and differential diagnoses of white matter disease, inflammation, and degeneration
  - Imaging features of benign and malignant tumors of the skull, skull base, brain, spine, spinal cord and cranial and peripheral nerves and the role of FLAIR, MRS and diffusion weighted Imaging in brain tumors
  - Evolution of brain tumor classification systems and significance of 2016 WHO update
  - Genetic factors currently used in brain tumor diagnosis, as well as their relevance to treatment and prognosis.
  - Areas in which radiologists may be able to influence diagnosis and treatment in patients with primary brain tumors.
  - Role of nuclear medicine, including PET/PET-CT, in the diagnostic evaluation of disorders involving the central nervous system, skull, skull base, and spine
  - Imaging protocol of Thyroid and Parathyroid pathologies and application of Nuclear Medicine studies in the diagnosis (thyroiditis, solid and cystic nodules)
  - Imaging protocol of TM joint dislocation
  - Imaging protocol of Petrous Temporal Bone

Reporting Skills

- Report radiographs of skull in trauma and other common Eye/ENT and dental diseases under indirect supervision of the attending radiologist.
- Report MRI and CT brain and spine under direct supervision
- Report ultrasound neonatal brain under indirect supervision
- Report swallows, sialography and Dacrocystography under direct supervision
- Report oncological studies of the brain, skull, and spine

Common Clinical Presentations

Following is a broad enumeration of common clinical presentation and diseases to create a framework of knowledge, however, there is no real limit. All radiological applications related to Neurovascular system may be assessed.

- Headache
- Progressive headache
- Vomiting
- Fever
- Trauma
- Stroke
- Painful Horner's syndrome
- Painful cranial nerves palsies
- Coma, loss of consciousness
- Blindness and Visual field defects
- Seizures
- Pituitary dysfunction
- Raised intracranial pressure
- Stridor/ Hoarseness
- Difficulty in swallowing
- Sensorineural hearing loss, vertigo, tinnitus
- Neck lymphadenopathy
- Proptosis
- Salivary gland swelling
- Otalgia
- Radiculopathy, myelopathy
- Backache
- Cauda equina syndrome/Cord compression syndrome

Common Diseases

Acute:

- Intracranial hemorrhage (sub-arachnoid, intraparenchymal, sub-dural, epidural)
- Aneurysm
- Infections (meningitis, encephalitis) and complications (abscess and empyema)
- Venous sinus thrombosis
- Carotid and vertebral artery dissection
- Stroke

Sub-Acute:

- Common primary brain tumors (intra and extra-axial masses, Pineal tumors, intraventricular tumors)
- Metastatic disease
- Pituitary and supra-seller tumors
- Intracranial tumors
- Vascular malformations
- Demyelinating diseases (Multiple sclerosis)
- Neurodegenerative diseases
- Normal pressure hydrocephalus

Spine:

- Tumors and metastasis
- Infections (discitis, osteomyelitis, epidural abscess) tuberculosis, fungal
- Degenerative disc disease (Modic-classification)
- Syringomyelia
- Spinal fractures and dislocation
- Spinal stenosis, postoperative changes

Sinus Diseases:

- Sinusitis, polyposis, tumors

Teeth and Jaw:

- Infections, sclerosing and cystic lesions of the jaw, radiotherapy changes, generalized diseases involving teeth and jaw

Eye, Orbit and Ear:

- Indications of ultrasound, CT and MRI in orbital tumors, inflammatory orbital diseases, retinal detachment, persistent hyperplastic primary vitreous, Grave's ophthalmopathy, trauma, foreign bodies in the orbit, Carotid-cavernous fistula
- Lacrimal gland: tumors, inflammatory and lymphoid masses
- Developmental abnormalities of the ear, vascular abnormalities, inflammatory diseases and benign and malignant neoplasms

MUSCULOSKELETAL SYSTEM

Objectives:

At the end of residency programme, the resident comprehends and is able to:

Essential Knowledge and Critical Thinking

- Describe:
    - Common congenital dysplasia of the musculoskeletal system
    - Value of different imaging techniques in musculoskeletal disorders
    - Common imaging presentations of trauma involving the skeleton and soft tissue
    - Imaging presentation of degenerative disorders of the musculoskeletal system and to appreciate their clinical relevance
    - Imaging manifestations of musculoskeletal infection and inflammation
    - Imaging manifestations of metabolic diseases, including osteoporosis
    - Typical radiographic features of common bone tumors
    - MRI and CT features in infections acute and chronic (Bacterial & Tuberculous acute on chronic infections, Brodie's Abscess, Sclerosing osteomyelitis, septic arthritis

- Imaging features, causes, differential diagnosis and complications on plain x-rays, CT and MRI of the following Musculo-skeletal conditions
- Plan a CT examination in patients with common disorders of the musculoskeletal system and to adapt it to the individual situation with a dose as low as reasonably achievable

Reporting Skills
- Report plain x-rays and ultrasound under indirect supervision
- Report CT and MRI of MSK diseases under direct supervision of the attending radiologist.

Common Clinical Presentations
Following is a broad enumeration of common clinical presentation and diseases to create a framework of knowledge, however, there is no real limit. All radiological applications related to musculoskeletal system may be assessed.
- Trauma
- Bone and joint pain
- Fever
- Limping
- Gait problems
- Cord compression symptoms
- Cauda Equina Syndrome
- Bone and joint swelling
- Redness of skin and swelling
- Sciatica
- Radiculopathy and myelopathy
- Scoliosis
- Incidental finding on plain x-ray and CT scan
- Common inflammatory arthritis

Common Diseases
Dysplasia:
- Osteopoikiloisis, Melorheostosis, Osteopathia striata, Diaphyseal Dysplasia,
- Metaphyseal dysplasia (Pyle), Achondroplasia, Osteogenesis imperfect, Osteopetrosis
- Neurofibromatosis, Fibrous dysplasia

Tumors:

- Enchondroma, Osteochondroma, Chondrosarcoma, Osteosarcoma, Simple cyst and Aneurysmal bone cyst, Giant cell tumor, Ewing Sarcoma, osteogenic sarcoma, Chondrosarcoma,

Metabolic Bone Disease:

- Osteomalacia, Renal osteodystrophy, Primary hyperparathyroidism
- Secondary hyperparathyroidism, fibrous dysplasia, Paget's disease

Joints:

- Degenerative, Rheumatoid arthritis, Psoriatic arthritis, Ankylosing spondylitis, Gout, prostheses and complications
- Heamaglobinopathies and myelofibrosis

Miscellaneous:

- Talipes equinovarus (clubfoot)
- Pes planus, Pes cavus
- Acromegaly
- Bone and joint infections

OBSTETRICS AND GYNAECOLOGY

Objectives:

At the end of residency programme, the resident comprehends and is able to:

Essential Knowledge and Critical Thinking

- Describe:
    - Principles of imaging acute abdomen in a pregnant lady
    - Common clinical presentations of acute conditions of obstetrics and gynecology
    - Ectopic pregnancy
    - Placenta previa and abruptio placenta
    - Ovarian torsion on ultrasound, CT, and MRI
    - Causes of per-vaginal bleeding in a pregnant female (threatened, inevitable, incomplete & missed abortion)

- Ultrasound assessment of fetal age, Evaluation of fetal growth, biophysical profile, the principals of Doppler ultrasound
- Congenital malformations of the uterus, including uterus septatus, uterus bicornis (unicollis and bicollis) and uterus didelphys
- Parameters of MR pelvimetric measurements
- Principles of fetal MR imaging technology
- Various stages of embryonic and fetal development and their respective appearance on MR imaging
- Applications of angiography & vascular interventional techniques in gynecological conditions

Reporting Skills

- Read and dictate radiographs and ultrasound of common diseases of female reproductive organs under indirect supervision of the attending radiologist
- Read and dictate CT and MRI of common diseases of the female reproductive organs under direct supervision of the attending radiologist
- Plan the proper MRI/CT examination of the female reproductive organs and to adapt it to the individual situation

Common Clinical Presentations

Following is a broad enumeration of common clinical presentation and diseases to create a framework of knowledge, however, there is no real limit. All radiological applications related to obstetrics and gynecology system may be assessed.

- Per-vaginal bleeding in a pregnant female
- Menorrhagia
- Amenorrhea (primary and secondary)
- Dysmenorrhea
- Vaginal discharge
- Anuria
- Lower abdominal pain
- Incontinence of urine
- Dysuria
- Lower abdominal fullness
- Vaginal prolapse

- Infertility
- Repeated abortions

Common Diseases
Uterus:
- Uterine agenesis, arcuate uterus, unicornuate uterus, uterus didelphys and bicornuate and septate uterus

Ovaries:
- Ovarian torsion
- Involuting Follicle or Follicular Cysts, infarction of ovarian cyst, hemorrhagic cyst, endomerioma
- Premature ovarian failure or primary ovarian insufficiency
- Tubo-Ovarian Abscess
- Tumors (benign and malignant with staging)
- Polycystic ovary syndrome and variants
- Follicle maturation studies

Fetus:
- Spina bifida
- Small posterior fossa
- Anencephaly
- Hydronephrosis
- Sacral agenesis
- Absent four chamber view of heart
- Polycystic kidney disease
- Cystic lesions of abdomen
- Hydrops

Trauma:
Pregnancy:
- Ectopic pregnancy, placenta previa and abruptio placenta
- Threatened, inevitable, incomplete and missed abortion

Tumors:
- Malignant tumors of the myometrium, endometrium, cervical cancer and FIGO classification
- Leiomyoma
- Adenomyosis uteri, endometriosis

Miscellaneous:

- Functional disorders of the cervix and uterus
- Imaging features of the uterus after different types of image-guided therapies

URORADIOLOGY

Objectives:

At the end of residency programme, the resident comprehends and is able to:

Essential Knowledge and Critical Thinking

- Describe:
  - Manifestations of urological & male genital diseases as demonstrated on conventional radiography, ultrasound, CT & MRI in both adults and children
  - Awareness of the application of angiography and vascular interventional techniques in urological cases

Reporting Skills

- Plan the proper MRI/CT/Ultrasound examination of the kidneys, ureters, bladder, and male reproductive organs and to adapt it to the individual situation

Common Clinical Presentations

Following is a broad enumeration of common clinical presentation and diseases but not limited to create a framework of knowledge, however, there is no real limit. All radiological applications related to Uroradiology may be assessed.

- Trauma
- Hematuria
- Lumbar pain
- Loin pain
- Dysuria/nocturia/anuria
- Scrotal pain/mass
- Raised PSA
- Male infertility
- Poor stream, frequency of micturition
- Retention of urine
- Renal mass seen on routine imaging examination
- Abdominal mass
- Erectile dysfunction

Common Diseases
Kidney:

- Nephrolithiasis
- Hydronephrosis
- Polycystic Kidney Disease and associated syndromes
- Benign and malignant tumors and staging (WHO classification)
- Renal injury and grading system
- Infections resulting in Pyelonephritis, Renal abscess
- Diabetic and hypertensive Nephropathy
- Fabry Disease
- Focal Segmental Glomerulosclerosis, Glomerulonephritis, IgA Nephropathy (Berger's Disease)
- Nephrotic Syndrome
- Renal artery stenosis
- Renal vein thrombosis
- Medullary sponge kidney
- Renal diseases in autoimmune conditions/
- Vasculitis, Polyarteritis Nodosa
- Radiation nephropathy
- Acute and chronic renal failure
- Dialysis and its complications
- Renal transplant and complications

Bladder, Ureters and Urethra:

- Hydro ureter
- Trauma to bladder(extra/ peritoneal leak)
- Ureterocele
- Stone disease
- Vesico-ureteral reflux
- Stress incontinence / Urinary incontinence
- Bladder outlet obstruction
- Neurogenic bladder
- Cystitis - inflammation of the bladder
- Overactive bladder
- Interstitial cystitis - a chronic problem that causes bladder pain and frequent, urgent urination
- Bladder tumors
- Epispadias and hypospadias
- Posterior urethral valves

- Infertility, hormonal imbalances, sexual dysfunction, Hypogonadism

Testis and Scrotum:
- Trauma
- Hydrocele
- Undescended testis (cryptorchidism)
- Testicular torsion
- Epididymo-orchitis
- Testicular microlithiasis
- Varicoceles
- Testicular tumors(benign and malignant tumors with WHO classification

INTERVENTIONAL RADIOLOGY

Objectives:

At the end of residency programme, the resident comprehends and is able to:

Essential Knowledge and Critical Thinking
- Describe:
  - Normal anatomy and Variant of the arterial, venous, and lymphatic system and its relevance to interventional radiology
  - Standard procedure in emergency situations, including resuscitation techniques
  - Techniques and Indications of typical endovascular approaches to common disorders in interventional radiology (Diagnostic arteriography Percutaneous central venous access) femoral artery puncture techniques /Saldinger technique and the introduction of guide wires and catheters into the arterial system
  - Technique to Thrombolysis, Embolization and Vascular stent placement
  - Approaches for image-guided biopsy and placement of drainages
  - Risk involved in common interventional techniques
  - Use, dosage, and administration of local anesthetics
  - Pharmacology, administration, and patient supervision in relation to intravenous administration of sedation

- Technique of Trans jugular intrahepatic portosystemic shunt and Chemoembolization, Transjugular/plugged liver biopsy, Percutaneous biliary drainage procedures and/or stent insertion
- Techniques of Aortic stent grafting (thoraco-abdominal), Cerebral AVM – embolization and Intracranial aneurysmal coiling
- Complications of intervention including but not limited to vasospasm, arterial dissection, thrombosis, catheterisation failure (alternative access/catheters/ guidecatheters), coil migration and malpositions
- Techniques of Gastointestinal interventions and stents placement and Percutaneous gastrostomy
- Indications for nephrostomy drainage, abscess drainage and pleural drainage, ureteric dilatation/ stent insertion, varicoceles embolization, renal biopsy/ cyst aspiration
- Technique of Radiofrequency ablation

Reporting Skills

- Read and dictate interventional procedures under direct supervision of the attending radiologist
- Plan the pre workup for interventional examinations
- Plan the use of sedation/deep sedation and anesthesia and adapt it to the individual situation

Common Clinical Presentations and Diseases

Following is a broad enumeration of common clinical presentation and diseases but not limited to create a framework of knowledge. All radiological applications related to vascular intervention system may be assessed.

- Trauma: (preparation of patient for angiographic studies in vessel damage)
- Role of vascular intervention in GI bleeding studies: (patient preparation) and the role of anticoagulants, vasodilators, and thrombolytic agents in GI bleeding
- Evaluation of occult acute and chronic gastrointestinal blood loss
- Contrast reaction management
- Vasovagal syncope management

- Pseudo aneurysm management at the site of puncture
- Vascular sheath care
- Ultrasound and CT guided interventional procedures, complications and management
- Anatomy and pathology of Peripheral Arterial Disease
- Aortic Dissection and Aneurysmal Disease
- Cerebrovascular Accident/Stroke
- Anatomy and pathology Visceral Arterial Pathology
- Mesenteric Ischemia
- Complications of intervention including but not limited to vasospasm, arterial dissection, thrombosis, catheterisation failure (alternative access/catheters/guidecatheters), coil migration and malpositions
- Peripheral venous disease including deep venous thrombosis, varicose veins
- Pulmonary Thromboembolic disease
- Superior and Inferior Vena Cava disease
- Portal and Hepatic venous interventions
- Gonadal venous interventions
- Central venous access
- Venous sampling
- Image-Guided Ablation
- Hepatic Disease
- Renal Disease
- Lung Disease
- Skeletal Disease

NUCLEAR MEDICINE

Objectives:

At the end of residency programme, the resident comprehends and is able to:

Essential Knowledge and Critical Thinking

- Describe:
  - Relevant aspects of current legislation regarding the administration of radiopharmaceuticals under PNRA
  - Principles and indications of the more commonly performed Nuclear Medicine investigations and how these relate to other imaging modalities

- Investigations in the following areas:
  - Cardiology
  - Endocrinology
  - Gastroenterology and hepato-biliary diseases
  - Haematology
  - Infections
  - Lung disease
  - Nephro-urology
  - Nervous system
  - Oncology
  - Paediatrics
  - Skeletal disorders
- Significance of normal and abnormal results
- Relevant patient preparation, precautions (including drug effects), and complications of the more commonly performed Nuclear Medicine investigations
- Strengths and weaknesses of Nuclear Medicine investigations to other imaging modalities
- Basic principles of physics including the basic atomic structure, principles of radioactivity and basic of radioactive decay
- Desirable characteristics and physiological clearance of radiopharmaceuticals and PET-tracers
- Principles of biological and effective half-life
- Principles of quantification of PET studies including standardized uptake values (SUV)
- Basic physical principles of nuclear medicine imaging technology, including gamma cameras, single photon emission computed tomography (SPECT), and positron emission tomography (PET)
- Basic physical principles of hybrid imaging, including PET-CT, SPECT-CT, and MR-PET
- Safety aspects in nuclear medicine and hybrid imaging, including patient dosimetry, staff dosimetry, contamination, monitoring, choice of equipment, quality control and safety/risk management

Reporting Skills

- Identify urgent and/or unexpected findings in nuclear medicine and hybrid imaging examinations and to communicate these timely and properly
- Apply the appropriateness criteria and indications for nuclear medicine and hybrid imaging procedures under guidance of nuclear medicine specialists
- Assist referring physicians in selecting the best-suited nuclear medicine or hybrid imaging examination for common indications
- Communicate with the patient in order to inform them about the procedures and obtain informed consent prior to nuclear medicine or hybrid imaging studies
- Choose optimal imaging protocols for nuclear medicine and hybrid imaging examinations under supervision
- Interpret and report common nuclear medicine and hybrid imaging studies under direct supervision
- Participate in multidisciplinary clinical reviews and tumor boards under supervision

Common Clinical Conditions and Their Interpretation

Following is a broad enumeration of common clinical presentation and diseases but not limited to create a framework of knowledge. All radiological applications related to Nuclear Medicine may be assessed.

Bone Scintigraphy:

- Bone metastasis/ metabolic bone disease, osteomyelitis, primary bone tumors

Kidney:

- Function of kidneys, PUJ obstruction, Vesico-ureteric reflux, cortical scarring

CNS:

- Cerebral metabolism and perfusion studies

Endocrine:

- Adrenal, thyroid and parathyroid uptake studies

GIT:
- GI transit studies, GI bleeding, Meckel's diverticulum, Hepatobiliary studies
- Infections and Inflammation: (basic mechanism of infection and occult sepsis)

Lymphoscintigraphy:
- Sentinel node localization and knowledge of spread of cancer)

Respiratory System:
- Pulmonary embolism studies, Ventilation perfusion studies

CVS:
- Myocardial perfusion studies

Paediatrics:
- Use of radionuclide in paediatric population and understanding of growing skeleton

PAEDIATRIC RADIOLOGY

Objectives:

At the end of residency programme, the resident comprehends and is able to describe:

Essential Knowledge and Critical Thinking

Normal paediatric anatomy and normal variants:
- Normal anatomy
- Common congenital disorders of the different body regions and their respective relevance for the child´s further development
- How to establish bone age based on radiographic findings?
- Significance of normal maturation and growth

Techniques and Indications
- Principles of establishing a child-friendly environment
- Relative indications of ultrasound, CT, and MRI in children
- Knowledge of increased vulnerability of children to ionizing radiation

- The ALARA principle and the special requirements for radiation safety and contrast material dosage in relation to body mass for the paediatric population
- High-risk factors for the allergic reactions to intravenous contrast media in paediatric population
- Imaging guidelines for Paediatric Cancer patients
- Techniques of intervention in paediatric population
- Proper clinical and radiologic indications in paediatric population for the following studies:
  - IVU
  - Cystogram
  - Voiding cystourethrogram
  - Ultrasonography
  - Upper and lower GI contrast studies
  - Nuclear Medicine studies and PET
  - CT
  - MRI

Common Pathologies

- Imaging features of common disease entities specific to the paediatric age group

Reporting Skills

Objectives:

At the end of residency programme, the resident is able to:

- Read and dictate radiographs, ultrasound, CT, and MRI of common diseases of the paediatric patients under direct and indirect supervision of the attending radiologist
- Plan the proper MRI/CT examination in paediatric age group understanding the use of sedation/deep sedation and anesthesia and to adapt it to the individual situation

Common Clinical Presentations

Following is a broad enumeration of common clinical presentation and diseases but not limited to create a framework of knowledge, however, there is no real limit. All radiological applications related to paediatric radiology may be assessed.

- Failure to thrive
- Irritability
- Cough, running nose and fever
- Tachypnea/intercostal recession
- Fever of unknown origin
- Abdominal pain
- Projectile vomiting/bilious vomiting
- Currant jelly stools
- Drooling
- Inability to pass meconium
- Poor urine stream
- Urine infection
- Testicular pain
- Loss of consciousness
- Trauma
- Bone and joint pain
- Paralysis or weakness on half of the body or face
- Increased intracranial pressure (ICP)
- Drowsiness and/or confusion
- Personality changes/impaired judgment
- Short-term memory loss
- Gait disturbances
- Communication problems

Common Diseases

Chest:

Bronchiolitis, pneumonia, pleural effusion, pneumothorax, foreign body aspiration, thymus and variants, Trauma to chest, Malignant mediastinal tumors, Lymphoma and leukemia, Malignant germ cell tumors, Neurogenic tumors, Pulmonary and chest wall malignancies, Carcinoid tumor, Pleuropulmonary blastoma, Askin tumor, foregut duplication cyst, pericardial cyst, Hemangioma lymphangioma

GIT:
Intestinal obstruction, necrotizing enterocolitis, blunt trauma, pneumoperitoneum, gastro-esophageal reflux, hypertrophic pyloric stenosis, malrotation, Hirschsprung's disease, anal imperforation and esophageal atresia, primary and secondary tumors of bowel, Infantile hepatic hemangioendothelioma, Mesenchymal Hamartoma of liver, Nodular regenerative hyperplasia, Hepatic hemangioma, Hepatoblastoma, Billiary tract rhabdomyosarcoma, Angiosarcoma and Metastatic disease

GUT:
Vesico-ureteral reflux and urethral anomalies, imperforate hymen, posterior urethral valves, hydronephrosis, testicular/ ovarian torsion, Wilms Tumor, Renal Cell Cancer (RCC), Rhabdoid Tumor of the Kidney, Clear Cell Sarcoma of the Kidney, Congenital Mesoblastic Nephroma, Ewing Sarcoma of the Kidney, Primary Renal Myoepithelial Carcinoma, Cystic Partially Differentiated Nephroblastoma, Multilocular Cystic Nephroma, Primary Renal Synovial Sarcoma, Anaplastic Sarcoma of the Kidney

CNS:
Traumatic brain injury (accidental and non-accidental), congenital disorders of the brain and spine, hypoxic injury to the brain, intracranial hemorrhage, Astrocytomas, brain stem glioma, optic nerve glioma, Ependymomas, Primitive neuroectodermal tumors (PNET), Medulloblastomas, Craniopharyngiomas, Pineal region tumors

Musculo Skeltal (MSK) System:
Salter Harris fractures, non-accidental injury, osteomyelitis, joint effusion, Legg–Calvé–Perthes disease and slipped capital femoral epiphysis, Osteosarcoma, Ewing Sarcoma/ Primitive Neuroectodermal Tumor, Rhabdomyosarcoma

TECHINICAL COMPETENCIES

The technical competencies, a specialist must have, are varied and complex. A list of the essential technical competencies including those required during training in the Diagnostic Radiology is given below. The level of competencies to be achieved each year is specified according to the key, as follows:

1. Observer Status
2. Assistant Status
3. Performed Under Supervision
4. Performed Under Indirect Supervision

COMPETENCIES	THIRD YEAR								TOTAL # OF CASES
	27 MONTHS		30 MONTHS		33 MONTHS		36 MONTHS		
	Level	Cases	Level	Cases	Level	Cases	Level	Cases	
REPORTING									
GENERAL X-RAY REPORTING	4	30	4	30	4	20	4	30	110
ULTRASOUND OF ABDOMEN	4	30	4	30	4	20	4	30	110
ULTRASOUND, PELVIS AND OBSTETRICS & GYNAECOLOGY	4	30	4	30	4	20	4	30	110
DOPPLER ULTRASOUND	4	30	4	30	4	10	4	10	80
CT- AND ULTRASOUND- GUIDED PROCEDURES	4	3	4	3	4	2	4	5	13
CT SCAN									
• HEAD AND NECK	4	20	4	20	4	10	4	10	60
• CHEST ABDOMEN ABD AND PELVIS	4	15	4	15	4	15	4	10	55
• MSK	4	10	4	10	4	10	4	10	40
• CTA	4	3	4	3	4	2	4	2	10
MAMMOGRAPHY	4	3	4	3	4	5	4	5	16
C.T. FLUOROSCOPY	4	4	4	4	4	3	4	4	15
MISCELLANEOUS									
RETROGRADE URETHROGRAM MCUG, HYSTERIA, MCUG	4	3	4	3	4	2	4	2	10
MRI									
• HEAD AND NECK, SPINE	4	10	4	10	4	15	4	15	50
• CHEST, ABDOMINAL AND PELVIS	4	10	4	10	4	10	4	10	40
• MSK	4	10	4	10	4	10	4	10	40

COMPETENCIES	FOURTH YEAR								TOTAL # OF CASES
	39 MONTHS		42 MONTHS		45 MONTHS		48 MONTHS		
	Level	Cases	Level	Cases	Level	Cases	Level	Cases	
REPORTING									
GENERAL X-RAY REPORTING	4	15	4	15	4	15	4	15	60
ULTRASOUND OF ABDOMEN	4	20	4	20	4	20	4	20	80
ULTRASOUND, PELVIS, OBSTETRICS & GYNAECOLOGY	4	20	4	20	4	20	4	20	80
DOPPLER ULTRASOUND	4	10	4	10	4	10	4	10	40
CT- AND ULTRASOUND- GUIDED PROCEDURES	4	5	4	5	4	5	4	5	20
CT SCAN									
• HEAD AND NECK	4	20	4	20	4	20	4	20	80
• CHEST ABDOMEN ABD AND PELVIS	4	20	4	20	4	20	4	20	80
• MSK	4	10	4	10	4	10	4	10	40
• CTA	3	5	3	5	4	5	4	5	20
MAMMOGRAPHY	4	10	4	10	4	10	4	10	40
C.T. FLUOROSCOPY	4	3	4	3	4	3	4	3	12
MISCELLANEOUS									
RETROGRADE URETHROGRAM MCUG, HYSTERIA, MCUG	4	2	4	2	4	2	4	2	8
MRI									
• HEAD AND NECK, SPINE	4	5	4	5	4	5	4	10	25
• CHEST, ABDOMINAL AND PELVIS	4	2	4	2	4	3	4	3	10
• MSK	4	2	4	3	4	3	4	4	12

INTRA-DEPARTMENTAL ROTATIONS

ABOVE COMPETENCIES CAN BE ACQUIRED THROUGH INTRA-DEPARTMENTAL ROTATIONS AS FOLLOWS:

	R-3	R-4
IVP+FLURO	1 MONTH	1 MONTH
ULTRASOUND	2 MONTHS	2 MONTHS
CT	2 MONTHS	3 MONTHS
MRI	2 MONTHS	2 MONTHS
GENERAL REPORTING/ER	1 MONTH	1 MONTH
WOMEN IMAGING/BREAST	1 MONTH	1 MONTH
PAEDS (IF CENTER DOES NOT HAVE DEDICATED PAEDS ROTATION, THEN ADJUST THESE TWO MONTHS IN US, CT, AND MRI IN RESPECTIVE YEARS)	-	1 MONTH
VASCULAR AND INTERVENTIONAL RADIOLOGY (DSA)	1 MONTH	1 MONTH
ELECTIVE ROTATION ON DISCRETION OF DEPARTMENT ACCORDING TO RESIDENT'S NEED	1 MONTH	-

VASCULAR AND INTERVENTIONAL RADIOLOGY (4 WEEKS)	LEVEL	CASES
REPORTING		
ANGIOGRAPHY AND VASCULAR INTERVENTIONS	LEVEL 2 TOTAL CASES 15 ANYTIME IN LAST 2 YEARS TRAINING	

ASSESSMENT

FORMATIVE ASSESSMENT

College of Physicians and Surgeons Pakistan, in order to implement competency-based education in letter and spirit, is introducing Work Placed Based Assessment (WPBA) in addition to institutional/ departmental assessments. To begin with college is introducing Mini-CEX / Mini-IPX and DOPS to ensure that the graduates are fully equipped with the clinical competencies.

Mini-Imaging Interpretation Exercise (MINI-IPX)

During training in Diagnostic Radiology, at least one Mini-IPX in each quarter is to be conducted as per the earmarked topics given below:

- Mini-IPX is intended to assess a resident's skills in interpreting an imaging study & to provide rapid & prompt feedback to the resident about her/his diagnostic skills.
- Mini-IPX is entirely a formative tool of assessment and is to be accompanied with constructive feedback.
- Each Mini-IPX encounter extends for about 20 minutes with 05 minutes for feedback and further action plan.
- The trainee should initiate the process by identifying the imaging study to be assessed (like CT chest and abdomen).
- It is mandatory that resident already has the experience of reporting similar cases under supervision.
- Where the mini-IPX involves patient interaction, it is to be ensured that the patient is aware that the mini-IPX is being carried out, like in ultrasound.
- An Assessor will directly observe the Resident performing the activity and then rate the performance on the attributes outlined in the assessment form keeping the resident's expected training level in consideration.
- Feedback will be provided to the resident immediately after the assessment including specific written comments on areas of good practice and constructive feedback on areas for further development. The resident will be encouraged to provide comments on his/her performance and what actions he/she plans for further improvement.

- In case of unsatisfactory performance of the resident, a remedial has to be completed within stipulated time frame
- Non-compliance by the resident has to be reported in quarterly feedback.
- The performance is reported online on the prescribed form (sample given below)

LIST OF TOPICS FOR MINI-IPX:

YEAR-3

QUARTER-1
- CT KUB / FACT / PNS

QUARTER-2
- MRI Spine

QUARTER-3
- CT Abdomen

QUARTER-4
- CT Chest

YEAR-4

QUARTER-1
- Diagnostic Mammography (Special views & Ultrasound correlation)

QUARTER-2
- MRI Knee

QUARTER-3
- CTA, MRA

QUARTER-4
- Head & Neck CT

MINI-IMAGING INTERPRETATION EXERCISE (MINI-IPX)

FCPS DIAGNOSTIC RADIOLOGY
Time Duration = 20 mins (15 mins assessment and 5 mins feedback)

PLEASE COMPLETE THE QUESTIONNAIRE BY FILLING/CHECKING APPROPRIATE BOXES

Assessor: _____ Assessment Date: _____

Resident's Name: _____

Hospital Name: _____ RTMC Number: _____

Specialty: _____

Years of Residency: ☐ R1 ☐ R2 ☐ R3 ☐ R4

Quarter: ☐ 1st ☐ 2nd ☐ 3rd ☐ 4th

Modality: ☐ Plain Film ☐ Fluoroscopy ☐ Ultrasound ☐ CT ☐ MRI
☐ Interventional Radiology ☐ Radionuclide Imaging/PET CT

System: ☐ Neuro/ENT ☐ Thoracic (CV/Resp) ☐ GI/HPB ☐ Genito-urinary
☐ Musculoskeletal ☐ Obstetrics/Gynecology/Breast

Complexity of Case/ Procedure: ☐ Low/Easy ☐ Moderate/Average ☐ High/Difficult
☐ N/A

Number of times procedure performed by resident: (approximately) _____

PLEASE GRADE THE FOLLOWING AREAS ON GIVEN SCALE:	NOT OBSERVED / APPLICABLE	BELOW EXPECTATIONS		SATISFACTORY	ABOVE EXPECTATIONS	EXCELLENT
		1	2	3	4	5
WHEN GIVEN, IS THE CLINICAL QUESTION WRITTEN?						
UNDERSTANDING OF RELEVANT ANATOMY						
APPROPRIATE REFERENCE TO PREVIOUS INVESTIGATIONS						
OBSERVATION OF FINDINGS IMAGE INTERPRETATION						
CONCLUSION / D/D (DOES THE REPORT ANSWER THE CLINICAL QUESTION?)						
FURTHER RECOMMENDATION GIVEN						
OVERALL CLINICAL JUDGEMENT						

Assessor's Satisfaction with Mini-IPX:

(Low) 1 2 3 4 5 (high)

Resident's Satisfaction with Mini-IPX:

(Low) 1 2 3 4 5 (high)

Strengths	Suggestions for Improvement

Encounter to be repeated: ☐ **YES** ☐ **NO**

Signature: _____

Direct Observation of Procedural Skills (DOPS)

During training in Diagnostic Radiology, at least one DOPS in each quarter is to be conducted as per the earmarked topics/ procedures given below:

- DOPS is entirely a formative tool of assessment and is to be accompanied with constructive feedback.
- Each DOPS encounter extends for about 20 minutes with 05 minutes for feedback and further action plan.
- The trainee should initiate the process by identifying the procedure to be assessed.
- Every procedure needs to be observed/assisted/performed under supervision at least once before the assessment can take place. Number of assisted procedures are mandatory to be mentioned on the assessment form.
- Prior to the start of a procedure being assessed, the form needs to be discussed between the assessor and the resident.
- An assessor will directly observe the resident undertaking a procedure and then rate his/her performance on the prescribed DOPS form.
- Feedback will be provided to the resident immediately after the assessment including specific written comments on areas of good practice and constructive feedback on areas for further development. The resident will be encouraged to provide comments on his/her performance and what actions he/she plans for further improvement.
- In case of unsatisfactory performance of the resident, a remedial has to be completed within stipulated time frame.
- Non-compliance by the resident has to be reported in quarterly feedback.
- The performance is reported online on the prescribed form (sample given below):

LIST OF TOPICS FOR DOPS:

YEAR-3

QUARTER-1

- Carotid Doppler

QUARTER-2

- FNA

QUARTER-3

- Core biopsy - Large masses

QUARTER-4

- Paediatric Fluoroscopy e.g. MCUG / GIT studies

YEAR-4

QUARTER-1

- Catheter / Drainage tube placement for ascites / pleural cavity

QUARTER-2

- Abscess drainage (Liver, Collections)

QUARTER-3

- CT guided intervention

QUARTER-4

- Basic Seldinger technique for vascular access / PICC line

OBSERVATION OF PROCEDURAL SKILLS (DOPS)

FCPS DIAGNOSTIC RADIOLOGY
Time Duration = 20 mins (15 mins assessment and 5 mins feedback)

PLEASE COMPLETE THE QUESTIONNAIRE BY FILLING/CHECKING APPROPRIATE BOXES

Assessor: _____ Assessment Date: _____

Resident's Name: _____

Hospital Name: _____ RTMC Number: _____

Specialty: _____

Years of Residency: ☐ R1 ☐ R2 ☐ R3 ☐ R4

Quarter: ☐ 1st ☐ 2nd ☐ 3rd ☐ 4th

Setting: ☐ O.T. ☐ Procedure Room ☐ Other: _____

Diagnosis of Patient: _____ Patient Age: Sex: _____

Complexity of Case/ Procedure: ☐ Low/Easy ☐ Moderate/Average ☐ High/Difficult ☐ N/A

Number of times procedure performed by resident: _____

PLEASE GRADE THE FOLLOWING AREAS ON GIVEN SCALE:	NOT OBSERVED / APPLICABLE	BELOW EXPECTATIONS		SATISFACTORY	ABOVE EXPECTATIONS	EXCELLENT
		1	2	3	4	5
INDICATIONS, ANATOMY AND STEPS OF PROCEDURE						
INFORMED CONSENT, WITH EXPLANATION OF PROCEDURE AND COMPLICATIONS						
PREPARATION FOR PROCEDURE ACCORDING TO ACCEPTED PROTOCOL						
USE OF LOCAL ANALGESIA OR SEDATION						
OBSERVANCE OF ASEPSIS						
SAFE USE OF INSTRUMENTS / MACHINES						
USE OF ACCEPTED TECHNIQUES						
MANAGEMENT OF UNEXPECTED EVENT (OR SEEKS HELP)						
POST-PROCEDURE INSTRUCTIONS TO PATIENT AND STAFF						
APPLICATION OF RADIATION PROTECTION PRINCIPLES						
PROFESSIONALISM						
OVERALL ABILITY TO PERFORM WHOLE PROCEDURE						

Assessor's Satisfaction with DOPS:

(Low) 1 2 3 4 5 (high)

Resident's Satisfaction with DOPS:

(Low) 1 2 3 4 5 (high)

Strengths	Suggestions for Improvement

Encounter to be repeated: ☐ YES ☐ NO

Signature: _____

SUMMATIVE ASSESSMENT:

The eligibility requirements for residents appearing in FCPS-II:

- Passed FCPS-I in Diagnostic Radiology or granted official exemption
- To have undertaken two years of RTMC registered training of Intermediate Module in Diagnostic Radiology after passing FCPS Part-I, in an institution recognized by CPSP
- To have undertaken further two years of advanced training in Diagnostic Radiology, in an institution recognized by CPSP
- To provide certificate of having passed Intermediate Module in Diagnostic Radiology
- Completion of entries in e-logbook along with validation by the supervisor
- Completed CPSP mandated Mini-IPX & DOPS in e-logbook• To provide certificate of attendance of mandatory workshops
- Provided evidence of publication of one research paper in a CPSP approved journal, along with the application form

EXAMINATION SCHEDULE

- CPSP theory examinations may be held once or twice a year depending upon the number of candidates.
- Theory examinations are held in various cities of the country usually at Abbottabad, Bahawalpur, Faisalabad, Hyderabad, Islamabad, Karachi, Lahore, Larkana, Multan, Peshawar, Quetta and Rawalpindi, centres. The College shall decide where to hold oral/practical examination depending on the number of residents in a city and shall inform the residents accordingly
- English shall be the medium of examination for the theory/ practical/ clinical and viva examinations
- The College will notify of any change in the centres, the dates and format of the examination
- A competent authority appointed by the College has the power to debar any resident from any examination if it is satisfied that such a resident is not a fit person to take the College examination because of using unfair means in the examination, misconduct or other disciplinary reasons

- Each successful resident in the Fellowship examination shall be entitled to the award of a College Diploma after being elected by the College Council and payment of registration fees and other dues

EXAMINATION FEES

- Fees deposited for a particular examination shall not be carried over to the next examination in case of withdrawal/ absence/exclusion
- Applications along with the prescribed examination fees and required documents must be submitted by the last date notified for this purpose before each examination
- The details of examination fee and fees for change of centre, subject, etc. shall be notified before each examination.

REFUND OF FEES

If, after submitting an application for examination, a resident decides not to appear, a written request for a refund must be submitted before the last date for withdrawal with the receipt of applications. In such cases a refund is admissible to the extent of 75% of fees only. No request for refund will be accepted after the closing date for receipt of applications.

If an application is rejected by the CPSP, 75% of the examination fee will be refunded, the remaining 25% being retained as a processing charge. No refund will be made for fees paid for any other reason, e.g. late fee, change of centre/subject fee, etc.

FORMAT OF EXAMINATIONS

Every candidate applying for the fellowship of the College of Physicians and Surgeons Pakistan must pass both parts of the Fellowship examination unless exemption is approved. Since the College is continually seeking to improve its examinations, changes are likely from time to time and candidates will be notified in advance of such changes.

Theory Examination:
Paper- I: 100 Single Best Type of MCQs
Paper- II: 100 Single Best Type of MCQs
Only those candidates who pass the theory examination will be eligible to appear in the clinical examination.

Clinical Examination:
The clinical examination comprises of the following:

- **Film Reporting Session**
- **Viva Voce**

RECOMMENDED BOOKS FOR IMM AND POST IMM (FCPS-II) DIAGNOSTIC RADIOLOGY

Intermediate Module (IMM)

Radiology

- Rad Primer by Elsevier https://www.radprimer.com
- Fundamentals of Diagnostic Imaging, Brant & Helms (3) ISBN-13: 978-1608319121
- Learning Radiology, by William Herring MD FACR. ISBN-13: 978-0323328074
- Chapman & Nakielny's Aids to Radiological Differential Diagnosis, 6th Edition. Expert Consult -Authors: Stephen Davies. Paperback ISBN: 9780702051760
- Grainger & Allison's Diagnostic Radiology. A Textbook of Medical Imaging, 6th edition. Churchill Livingstone Elsevier. (2) (IMM & FCPS)
- Grainger & Allison's Diagnostic Radiology Essentials (2) Lee Grant, Nyree Griffin
- Primer of Diagnostic Imaging: Expert Consult, 5th edition. Weissleder R, Wittenberg J, Harisinghani M and Chen JW (2011) Elsevier Mosby. (2) ISBN-13: 978-0323065382
- Radiology Review Manual (3) by Wolfgang Dahnert MD (Author) ISBN-13: 978-1609139438
- Atlas of Normal Roentgen Variants That May Simulate Disease by Theodore E. Keats MD (Author), Mark W. Anderson MD (Author) ISBN-13: 978-0323073554
- Felson's Principles of Chest Roentgenology ISBN-13: 978-1455774838
- Practical Fluoroscopy of the GI and GU Tracts. by Marc S. Levine (Author), Parvati Ramchandani (Author), Stephen E. Rubesin (Author), ISBN-13: 978-1107001800
- Fundamentals of Fluoroscopy. by Jeffrey D. Houston MD (Author), Michael Davis MD (Author). ISBN-13: 978-0721694078
- Diagnostic Ultrasound, Rumack CM, Wilson SR, Charboneau JW and Levine D (2011), 4th edition. Elsevier Mosby (2)
- Spiral and Multislice Computed Tomography of the Body, Prokop M and Galanski M (2003). Thieme

- Clinical MR Imaging: APractical Approach. Reimer P, Parizel PM, Meaney JFM and Stichnoth FA (2010) Springer.

EMERGENCY RADIOLOGY

- Soto JA and Lucey BC (2009) Emergency Radiology: The Requisites. Elsevier Mosby
- Marincek B and Dondelinger RF (2011) Emergency Radiology: Imaging and Intervention. Springer.

ANATOMY

- Atlas of Human Cross-Sectional Anatomy: With CT and MR Images by Donald R. Cahill (Author), Matthew J. Orland (Author), Gary M. Miller (Author) ISBN-13: 978-0471591658
- Weir & Abrahams' Imaging Atlas of Human Anatomy Jonathan Spratt et al

PHYSICS

- The Essential Physics of Medical Imaging(IMM) by Jerrold T. Bushberg, J. Anthony Seibert , Edwin M. Leidholdt Jr. , John M. Boone ISBN-13: 978-0781780575
- Farr's Physics for Medical Imaging, 2nd Ed (Elsevier)
- Review of Radiologic Physics (2) (IMM) by Walter Huda MD ISBN-13: 978-0781785693
- Essential Nuclear Medicine Physics by Rachel A. Powsner, Edward R. Powsner ISBN-13: 978-1405104845

- www.pnra.org

RADIOLOGICAL TECHNIQUES AND PROCEDURES

- Chapman & Nakielny's Guide to Radiological Procedures. 7th Edition. Editors: Nick Watson Hefin Jones. ISBN: 9780702071669

POST IMM (FCPS-II)

RADIOLOGY

- Rad Primer by Elsevier https://www.radprimer.com
- StatDx by Elsevier https://www.statdx.com
- The Requisites Series (FCPS) ISBN-13: Various

EMERGENCY RADIOLOGY

- Emergency Radiology: Case Studies by David T. Schwartz (Author) ISBN-13: 978-0071409179
- Imaging in Trauma and Critical Care by Stuart E. Mirvis MD FACR (Author), Kathirkamanathan Shanmuganathan MD ISBN-13: 978-0721693408
- Accident and Emergency Radiology: A Survival Guide by Nigel Raby FRCR (Author), Laurence Berman MB BS FRCP FRCR (Author), Simon Morley FRCR (Author), Gerald de Lacey MA FRCR (Author ISBN-13: 978-0702042324
- Soto JA and Lucey BC (2009) Emergency Radiology: The Requisites. Elsevier Mosby
- Marincek B & Dondelinger RF (2011) Emergency Radiology: Imaging and Intervention. Springer.

CARDIOTHORACIC RADIOLOGY

- Chest Radiology: The Essentials by Janette Collins (Author), Eric J. Stem MD (Author) ISBN-13: 978-1451144482
- Thoracic Imaging: Pulmonary & Cardiovascular Radiology (2) (FCPS) by W. Richard Webb MD (Author), Charles B. Higgins (Author) ISBN-13: 978-1605479767
- Chest Radiology: Plain Film Patterns and Differential Diagnoses. by James C. Reed MD (Author) (2) ISBN-13: 978-1437723458
- Cardiac Imaging: The Requisites by Lawrence Boxt MD FACC FSCCT (Author), Suhny Abbara MD FACR FSCCT (Author), Stephen W. Miller MD (Author) ISBN-13: 978-0323055277
- Bogaert J, Dymarkowski S, Taylor AM and Muthurangu V (2012) Clinical Cardiac MRI (Medical Radiology), 2nd edition. Springer.
- Halpern EJ (2011) Clinical Cardiac CT: Anatomy and Function, 2nd edition.

ABDOMINAL RADIOLOGY

- Fundamentals of Body CT by W. Richard Webb MD (Author), Wiliam E. Brant MD FACR (Author), Nancy M. Major MD (Author) ISBN-13: 978-0323221467
- Essentials of Body MRI by William E. Brant (Editor), Eduard E. de Lange (Editor) ISBN-13: 978-0199738496

- CT and MRI of the Abdomen and Pelvis: A Teaching File by Pablo R. Ros (Editor), Koenraad J. Mortele MD (Editor) ISBN-13: 978-1451113525
- Boland GW (2013) Gastrointestinal Imaging: The Requisites, 4th edition. Elsevier Saunders
- Hamm B, Krestin GP, Laniado M, Nicolas V and Taupitz M (2009) MR Imaging of the Abdomen and Pelvis. Thieme.

MAMMOGRAPHY

- Breast Imaging Companion by Gilda Cardenosa MD FACR (Author) ISBN-13: 978-0781764919
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MUSCULOSKELETAL RADIOLOGY

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- Fundamentals of Skeletal Radiology Clyde Helms
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- Valji K (2012) The Practice of Interventional Radiology. Elsevier Saunders.
- Handbook of Interventional Radiologic Procedures, by Krishna Kandarpa MD PhD (Author), Lindsay Machan MD (Editor). ISBN-13: 978-0781768160
- Interventional Radiology: A Survival Guide. by David Kessel MB BS MA MRCP FRCR EBIR (Author), lain Robertson MB ChB MRCP FRCR. (Author). ISBN-13: 978-0702033896

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- Mafee MF, Valvassori GE and Becker M (2004) Imaging of the Head and Neck, 2nd edition. Thieme.

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COLLEGE OF PHYSICIANS AND SURGEONS PAKISTAN
7th Central Street, Defence Housing Authority, Karachi-75500.
Phone No. 9926400-10, UAN: 111-606-606, Fax No. 99266432