CURRICULUM MD
DIAGNOSTIC RADIOLOGY

Rawalpindi Medical University

Programme

MDDIAGNOSTIC RADIOLOGY

Medical education is not just a program for building knowledge and skills in its recipients…..it is also an experience which creates attitudes and expectations"

Abraham Flexner

Written on:18th March 2021

WMA DECLARATION OF GENEVA

Adopted by the 2nd General Assembly of the World Medical Association, Geneva, Switzerland, September 1948 and amended by the 22nd World Medical Assembly, Sydney, Australia, August 1968 and the 35th World Medical Assembly, Venice, Italy, October 1983 and the 46th WMA General Assembly, Stockholm, Sweden, September 1994 and editorially revised by the 170th WMA Council Session, Divonne-les- Bains, France, May 2005 and the 173rd WMA Council Session, Divonne-les-Bains, France, May 2006.

AT THE TIME OF BEING ADMITTED AS A MEMBER OF THE MEDICAL PROFESSION:

I SOLEMNLY PLEDGE to consecrate my life to the service of humanity;
I WILL GIVE to my teachers the respect and gratitude that is their due;
I WILL PRACTISE my profession with conscience and dignity;

THE HEALTH OF MY PATIENT will be my first consideration;
I WILL RESPECT the secrets that are confided in me, even after the patient has died;

I WILL MAINTAIN by all the means in my power, the honor and the noble traditions of the medical profession;

MY COLLEAGUES will be my sisters and brothers;

I WILL NOT PERMIT considerations of age, disease or disability, creed, ethnic origin, gender, nationality, political affiliation, race, sexual orientation, social standing or any other factor to intervene between my duty and my patient;

I WILL MAINTAIN the utmost respect for human life;

I WILL NOT USE my medical knowledge to violate human rights and civil liberties, even under threat;

I MAKE THESE PROMISES solemnly, freely and upon my honor.

Preface:

Thehorizons of*MedicalEducation*arewidening&therehasbeenasteadyriseofglobalinterestin*PostGraduateMedicalEducation*,anincreased awareness ofthenecessity forexperiencein education skillsforall healthcareprofessionalsand theneed forsomeformalrecognition ofpostgraduate trainingin Diagnostic Radiology.

Weareseeingariseintheuptakeofplacesonpostgraduatecoursesin medicaleducation,morefrequentissuesofmedicaleducationjournalsandthe furtherdevelopmentof e-journalsandothernewonlineresources.Thereis thereforeaneedtoprovideactivesupportin*PostGraduateMedical Education*for alarger,nationalgroupof colleaguesinallspecialtiesand atall stages of theirpersonalprofessionaldevelopment. If weweretoformulate astatementofintenttoexplainthepurposeofthiscurriculumwemightsimplysaythatouraimistohelpclinicalcolleaguestoteachandtohelp studentstolearninabetterandadvancedway.Thisbookisastateoftheartbookwithrepresentation ofallactivitiesoftheMD Diagnostic RadiologyprogramatRMU. Curriculumisincorporatedinthebookforconvenienceofsupervisorsandresidents. MScurriculumisbasedonsixCoreCompetencies ofACGME***(AccreditationCouncilfor Graduate MedicalEducation)***including***PatientCare,MedicalKnowledge,System BasedPractice,Practice Based Learning,Professionalism, Interpersonal andCommunicationSkills***.The missionof Rawalpindi MedicalUniversityistoimprovethehealth ofthe communitiesandweservethrougheducation,biomedicalresearchandhealthcare.Asanintegralpartofthismission,importanceofresearchculture andestablishmentof acomprehensiveresearchstructure andresearchcurriculumfor theresidentshas been formulated andprovidedin this book.

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SECTION 1:

1 Introduction

The Diagnostic Radiology curriculum provides the framework for thetraining of doctors to the level of independent consultant practice in diagnostic radiology,addressing the requirements of patients, the population and basic health services.

2 MISSION STATEMENT:

The mission of MD Diagnostic radiology program must be,

1. That the student accepts Radiology in its full sense as lifelong activity and that he/she is prepared to invest time and effort to acquire, maintain and further improve his/her own knowledge and skills.
2. A critical appreciation of techniques, procedures carried out in Radiology; an understanding of scientific methods, reliability and validity of observations and the testing of hypothesis.
3. The ability and willingness to adopt a problem solving approach to manage clinical situations included in the definition of Radiology.
4. The ability to plan and interpret management program with due regard to the patient's comfort and economic factors.
5. His / her awareness of the role of specialists of Radiology in Health / rehabilitation / welfare teams and his/her willingness to work cooperatively within such teams.
6. The awareness that he/she has to create his/her own professional impact as a capable specialist/ Teacher / Scholar of Radiology in the world.
7. To pursue and develop the basic scientific pursuits and guideline for scientific discoveries to strengthen knowledge further about human body requirements.
8. To set and pursue the highest goals for ourselves as we learn the science, craft, and art of Radiology.
9. To passionately teach our junior colleagues and students as we have been taught by those who preceded us.
10. To treat our colleagues and hospital staff with kindness, respect, generosity of spirit, and patience.
11. To foster the excellence and well-being of our residency program by generously offering our time, talent, and energy on its behalf.
12. To extend our talents outside the walls of our hospitals and clinics, to promote the health and well-being of communities, locally, nationally, and internationally.
13. To serve as proud ambassadors for the mission of the Rawalpindi Medical University MD Diagnostic Radiology Residency Program for the remainder of our professional lives.

3 Rationale of curriculum:

TheDiagnostic Radiologycurriculumwillproduceaworkforcefitfortheneedsofpatients,producingdoctorswhoaremorepatient-focused,more general and who have more flexibility in their career structure. The introduction ofupdated standards for curricula and assessment processes laid out in **Excellence by Design**requirescurriculatobebasedonhigh-leveloutcomes. Thehigh-leveloutcomesinthiscurriculumareintegralpartsofthesyllabustodescribetheprofessional tasks within the scope of specialty practice.

4 Training pathway and duration of training:

Trainees enter Diagnostic Radiology training via a Central Induction Process. Program has 2 phases. Phase 1 consists of 2 years training in Diagnostic Radiology with mandatory rotations in nuclear medicine, interventional radiology and MRI followed by Mid-term Assessment. Phase 2 also consists of 2 years training in Diagnostic Radiology with rotation in interventional radiology and Echocardiography followed by Final Assessment and Defense of Thesis.

Table 1:TRAINING PATHWAY & ROTATIONS

Year of training	Rotations			Assessment
Year 1	10 months+radiology	6weeks Nuclear medicine		MCQs
Year 2	9 months radiology	Interventional radiology- 1 month	MRI-I 2 months	MCQs OSCE
Year 3	11 months+ radiology	Echocardiography 2 weeks		MCQs
Year 4	9 months radiology	Interventional radiology 1 month	MRI-II 2 month	MCQs SEQS OSCE VIVA VOCE

SECTION 2: GENERAL

1. STATUTES

1. Nomenclature:

The name of degree programme shall be MD Diagnostic Radiology. This name is well Recognized and established for the last many decades worldwide.

2. Course Title:

MD Diagnostic Radiology

3. Training Centers:

Departments of Diagnostic Radiology at Rawalpindi Medical University (RMU).

4.**Duration of Course:**

The duration of MD Diagnostic Radiology course shall be four 04 years with structured training in a recognized department under the guidance of an approved supervisor.

5. **Course structure**:

The course is structured in two parts: After admission in M.D. Diagnostic Radiology Programme the resident will spend first 12 Months in the relevant Department of Radiology, during which resident will get orientation about the chosen discipline and will also undertake the mandatory workshops. The research project will be designed and the synopsis be prepared during this period.Resident will undergo 1st In-training Assessment at the end of 1st year. It will comprise 100 clinical/applied basics MCQs. Pass marks will be 50%.

The resident will continue formal training in the Basic Principals of Diagnostic Radiology for further 12 Months, during this period the resident must get the research synopsis approved by AS&RB of the university.

At the end of second year, trainee will undergo Midterm Examination. This Examination will comprise of written and clinical components. Pass percentage in this examination is 60%.

During the 3rd “& 4“years of the programme, there are two components of the training: -

1. Clinical Training in Diagnostic Radiology.

2. Research and Thesis writing.

The candidate shall undergo clinical training to achieve educational objectives of M.D. Diagnostic Radiology (knowledge and skills) along with rotations in the relevant fields. The clinical training shall be competency based. There shall be generic and specialty specific competencies and shall be assessed by continuous Internal Assessment.

Thesis writing will be started in the third year.

At the end of third year, again In-training assessment will be conducted consisting of MCQs based examination in which pass marks will be 50%.

In Fourth year preferably during first 6 months, thesis will be completed and approval by BASR will be taken. Following fulfillment of eligibility criteria, the trainee will appear in Final Assessment at the end of fourth year training that will comprise written and clinical components. Pass marks in this examination will be 60%.

2. ADMISSION CRITERIA

Applications for admission to MS Training Programs will be invited through advertisement in print and electronic media mentioning closing date of applications and date of Entry Examination.

Eligibility: The applicant on the last date of submission of applications for admission must possess the:

Basic Medical Qualification of MBBS or equivalent medical qualification recognized by Pakistan Medical Council.

Certificate of one year's House Job experience in institutions recognized by Pakistan Medical Council is essential at the time of interview. The applicant is required to submit Hope Certificate from the concerned Medical Superintendent that the House Job shall be completed before the Interview.

Valid certificate of permanent or provisional registration with Pakistan Medical Council.

MS entry exam pass certificate

3. REGISTRATION AND ENROLMENT

AsperpolicyofPakistanMedicalCouncilthenumberofPGTrainees/Studentspersupervisorshallbe maximum 05per annum for all PG programsincludingminor programs(if any).

- TheUniversitywill approvesupervisors forMDcourses.
- Candidatesselectedforthecourses:aftertheirenrollmentattherelevantinstitutionsshallberegisteredwith RMU asper prescribed RegistrationRegulations.

SECTION 3: PROGRAM

DEVELOPMENTAL MILESTONES FOR MD DIAGNOSTIC RADIOLOGY PROGRAM AT RAWALPINDI MEDICAL UNIVERSITY

This document presents milestones designed for programs to use in semi-annual review of resident performance and reporting to the ACGME. Milestones are knowledge, skills, attitudes, and other attributes for each of the ACGME competencies organized in a developmental framework from less to more advanced. They are descriptors and targets for resident performance as a resident moves from entry into diagnostic radiology residency through graduation. In the initial years of implementation, the Review Committee will examine milestone performance data for each program's residents as one element in the Next Accreditation System (NAS) to determine whether residents overall are progressing. For each reporting period, review and reporting will involve selecting the level of milestones that best describes each resident's current performance level in relation to milestones. Milestones are arranged into numbered levels. Selection of a level implies that the resident substantially demonstrates the milestones in that level, as well as those in lower levels. A general interpretation of levels for diagnostic radiology is below:

Level 1: The resident demonstrates milestones expected of one who has had some education in diagnostic radiology.

Level 2: The resident is advancing and demonstrating additional milestones.

Level 3: The resident continues to advance and demonstrate additional milestones; the resident consistently demonstrates the majority of milestones targeted for residency.

Level 4: The resident has advanced so that he or she now substantially demonstrates the milestones targeted for residency. This level is designed as the graduation target.

Level 5: The resident has advanced beyond performance targets set for residency and is demonstrating "aspirational" goals which might describe the performance of someone who has been in practice for several years. It is expected that only a few exceptional residents will reach this level.
These are described in **Appendix 1**

Table 2:Milestones levels

Milestones for high level outcome	**MilestonesLevel (endof** Year1**)**	**MilestonesLevel (endof** Year2**)**	**MilestonesLevel (endof** Year3**)**	**MilestonesLevel (endof** Year4**)**
Patient care and technical skills	L2	L3	L4	**L5**
Medical knowledge	L2	L3	L4	**L5**
professionalism	L1	L2	L3	**L4**
Interpersonal and communication skills	L2	L2	L3	**L5**
System based practice	L2	L2	L3	**L4**
Practice based learning and improvement	**L1**	**L2**	**L3**	**L5**

SECTION 4: TEACHING & LEARNING:

The curriculum is used to help design training program locally that ensure all trainees candevelopthenecessaryskillsandknowledgeinavarietyofsettingsandsituations.Thecurriculumisdesignedtoensureitcanbe appliedina flexiblemanner,meetingserviceneedsaswellassupportingeachtrainee'sowntailoredlearninganddevelopmentplan. Therequirementsforcurriculum delivery have not changed as a result of this new curriculum, the only difference is that this new curriculum is more structured in its delivery.

1) AIMS AND OBJECTIVES OF THE PROGRAM:

AIM

The aim of four years MD programme in Diagnostic Radiology is to train residents to acquire the competency of a specialist in the field of Diagnostic Radiology so that they can become good teachers, researchers and clinicians in their specialty after completion of their training.

GENERAL OBJECTIVES

1. To provide a broad experience in Diagnostic Radiology, including its inter relationship with other disciplines.
2. To enhance medical knowledge, clinical skills, and competence in diagnostic and therapeutic procedures.
3. To cultivate the correct professional attitude and enhance communication skill towards patients, their families
4. and other healthcare professionals.
5. To enhance sensitivity and responsiveness to community needs and the economics of health care delivery.
6. To enhance critical thinking, self-learning, and interest in research and development of patient service.
7. To cultivate the practice of evidence-based medicine and critical appraisal skills.
8. To inculcate a commitment to continuous medical education and professional development.
9. To provide a broad training and in-depth experience at a level for trainees to acquire competence and professionalism of a specialist in Diagnostic Radiology especially in the diagnosis, investigation and treatment of medical problems towards the delivery of holistic patient care.
10. To acquire competence in managing acute radiological emergencies referred by other doctors, and in selecting patients for timely referral to appropriate tertiary care or the expertise of another specialty.
11. To encourage the development of skills in communication and collaboration with the community towards healthcare delivery.
12. To foster the development of skills in the critical appraisal of new methods of investigation and/or treatment.
13. To reinforce self-learning and commitment to continued updating in all aspects of Diagnostic Radiology.
14. To encourage contributions aiming at advancement of knowledge and innovation in radiology through basicand/or clinical research and teaching of junior trainees and other health related professionals.
15. To acquire professional competence in training future trainees in Diagnostic Radiology at Rawalpindi Medical University.

2. SPECIFIC OBJECTIVES:

6 CORE COMPETENCIES OF CURRICULUM

Curriculum of MD Diagnostic Radiology at Rawalpindi Medical University is an important document that defines the educational goals of Residency Training Program and is intended to clarify the learning objectives for all inpatient and outpatient rotations. Program requirements are based on the **ACGME (Accreditation Council for Graduate Medical Education)** standards for categorical training in Diagnostic Radiology. Curriculum is based on 6 core competencies. Detail of these competencies is as follows

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COMPETENCYNO.1

PATIENT CARE:

Provide patient care that is compassionate, appropriate and effective.

Skills

- Gather essential and accurate information about patients
- Develop a diagnostic plan based upon the clinical question/s and relevant clinical,radiologic and pathologic information
- Oversee diagnostic imaging to ensure adequacy of studies performed
- Counsel patients concerning preparation for diagnostic testing
- Demonstrate a basic understanding of electronic patient information systems
- Demonstrate the ability to use the Internet as an educational instrument to expandmedical knowledge
- Demonstrate knowledge of the levels of ionizing radiation related to specificimaging procedures and employ measures to minimize radiation dose to thepatient
- Perform radiologic examinations appropriately and safely, assuring that thecorrect examination is ordered and performed

Education (with graduated faculty supervision and feedback)

- Practical experience in developing a differential diagnosis and management planbased upon clinical data, imaging findings and other medical test results
- Active participation in journal reviews to determine the effectiveness of
- diagnostic imaging for specific diagnostic questions
- Graduated responsibility in performing radiologic procedures
- Didactic instruction in radiation safety
- Preparation and presentation of radiologic cases to other members of the healthcare team

Assessment

- Global ratings by faculty
- 360 degree examination
- Procedure log
- Objective structured clinical examination

COMPETENCYNO.2

MEDICAL KNOWLEDGE:

Residents must demonstrate knowledge about established and evolving biomedical and clinical sciences and the application of this knowledge to patient care.

Skills

- Demonstrate sufficient knowledge of medicine and apply this knowledge toradiological studies in a clinical context to generate meaningful differentialdiagnoses
- Demonstrate progressive acquisition of radiological knowledge
- Demonstrate knowledge of the principles of research design and implementation
- Generate a clinically appropriate diagnostic treatment plan
- Demonstrate the ability to use all relevant information resources to acquireevidence-based data
- Understand how radiologic equipment can be used to generate appropriate and diagnostic images

Education

- Didactic lectures and self-directed learning on the science and practice ofradiology
- Participation in departmental and inter-departmental case conferences
- Participation in the clinical activities of the radiology department
- Departmental or institutional training programs on research design and
- implementation

Assessment

- Global ratings by faculty
- Program-developed written examinations
- ACR in-training examination
- Written examination
- Oral examination
- Raphex physics examination

COMPETENCYNO.3

INTERPERSONAL AND COMMUNICATION SKILLS:

Residents must demonstrate interpersonal and communication skills that result in effective information exchange with patients, patient family members, medical students, other residents, supervising faculty, referring physicians, technologists, nurses and other members of the health care team.

Skills

- Provide a clear and informative written radiologic report including a precise diagnosis whenever possible, a differential diagnosis when appropriate, and recommended follow-up or additional studies when appropriate
- Provide direct communication to the referring physician or appropriate clinical personnel when interpretation reveals an urgent or unexpected finding and document this communication in the radiologic report
- Demonstrate effective skills of face-to-face listening and speaking with
- physicians, patients, patient's families and support personnel
- Demonstrate appropriate telephone communication skills
- Demonstrate skills in obtaining informed consent, including effective
- communication to patients of the procedure, alternatives and possiblecomplications

Education (with graduated faculty supervision and feedback)

- Participation as an active member of the radiology team by communicating faceto-face with clinicians, answering the telephone, providing consults, problemsolving and decision-making
- Act as the contact person for technologists and nurses in managing patient andimaging issues
- Active participation in preparing and moderating multi-disciplinary conferences
- Practical experience in dictating radiological reports

Assessment

- Global ratings by faculty
- 360 degree evaluations
- Oral ABR examination
- Record review (systematic evaluation of resident dictations)

COMPETENCYNO.4

PROFESSIONALISM:

Demonstrate a commitment to carrying out professional responsibilities, adherence to ethical principles, and sensitivity to a diverse patient population.

Skills

- Demonstrate altruism (putting the interests of patients and others above own selfinterest)
- Demonstrate compassion: be understanding and respectful of the patients, patientfamilies, and staff and physicians caring for patients
- Demonstrate excellence: perform responsibilities at the highest level and continueactive learning throughout one's career
- Be honest with patients and all members of the health care team
- Demonstrate honor and integrity: avoid conflicts of interest when accepting giftsfrom patients or vendors
- Interact with others without discriminating on the basis of religious, ethnic, sexualor educational differences and without employing sexual or other types ofharassment
- Demonstrate knowledge of issues of impairment (i.e. physical, mental and alcoholand substance abuse), obligations for impaired physician reporting, and resourcesand options for care of self-impairment or impaired colleagues
- Demonstrate positive work habits, including punctuality and professionalAppearanceDemonstrate an understanding of broad principles of biomedical ethics
- Demonstrate principles of confidentiality with all information transmitted duringa patient encounter
- Demonstrate knowledge of regulatory issues pertaining to the use of humansubjects in research

Education

- Discussion of conflicts of interest and the ethics of conducting research duringdepartmental or institutional conferences and daily clinical work
- Training programs (i.e. videotapes) on the issues of harassment and
- discrimination.
- Didactic presentations on the recognition and management of the "impairedphysician"
- Participation in hospital-sponsored core curriculum educational activities (i.e.lectures, web-based programs)
- Didactic lecture/training program on the broad principles of medical ethics
- Institutional web-based self-directed learning and assessment programs on humansubjects research guidelines

Assessment

- Global ratings by faculty
- 360 degree evaluations
- Conference attendance logs
- Resident self-assessment
- Written ABR examination

COMPETENCYNO.5

PRACTICE BASED LEARNING AND IMPROVEMENT:

Residents must be able to investigate and evaluate their patient care practices, and appraise and assimilate scientific evidence in order to improve their radiologic practices.

Skills

- Analyze practice experience and perform practice-based improvement in cognitive knowledge, observational skills, formulating a synthesis andimpression, and procedural skills
- Demonstrate critical assessment of the scientific literature
- Demonstrate knowledge of and apply the principles of evidence-based medicinein practice
- Use multiple sources, including information technology to optimize life-longlearning and support patient care decisions
- Facilitate the learning of students, peers and other health care professionals

Education

- Participate in critical assessment of the scientific literature through journal clubs,clinical conferences and independent learning
- Didactic lectures on the assessment of scientific literature, study designs andstatistical methods
- Teaching students, peers and other health care professionals, with graduatedsupervision and feedback from supervising faculty
- Active participation in departmental or institutional quality assurance
- (QA)/quality improvement (QI) activities with faculty supervision

Assessment

- Global ratings by faculty
- ACR in-service examination
- Written ABR examination
- QA/QI conference attendance logs
- Global ratings by students
- Procedure log

COMPETENCYNO.6

SYSTEMS BASED PRACTICE:

Demonstrate an awareness and responsiveness to the larger context and system of health care and the ability to effectively call on system resources to provide optimal care.

Skills

- Demonstrate the ability to design cost-effective care plans based on knowledge ofbest practices
- Demonstrate knowledge of the sources of financing for U.S. health care including
- Medicare, Medicaid, the Veteran's Affairs and Department of Defense, publichealth systems, employer-based private health plans, and patient's own funds
- Demonstrate knowledge of basic health care reimbursement methods
- Demonstrate knowledge of the regulatory environment including state licensingauthority, state and local public health rules and regulations, and regulatoryagencies such as Centers for Medicaid and Medicare Services (CMS) and JointCommission for the Accreditation of Healthcare Organizations (JCAHO)
- Demonstrate knowledge of basic practice management principles such asbudgeting, record keeping, medical records, and the recruitment, hiring,
- supervision and management of staff

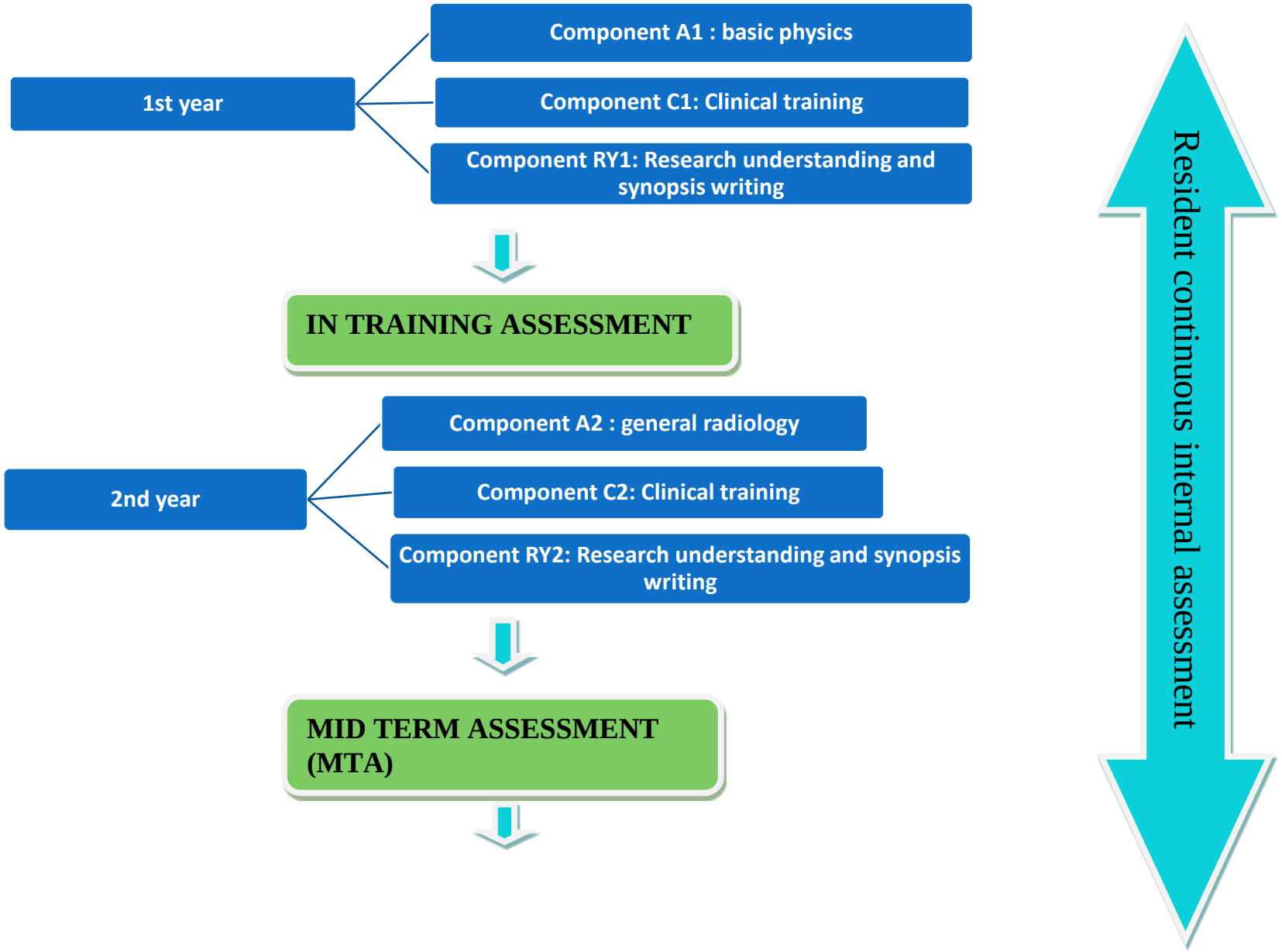
Education

- Systematic review of appropriate literature, including current American Collegeof Radiology (ACR) Appropriateness Criteria, to develop knowledge of evidencebasedindications for imaging procedures
- Attendance and active participation in departmental and multi-disciplinaryconferences where there is discussion of the imaging evaluation of specificdiseases and most appropriate and cost-effective methods for establishing adiagnosis
- Interaction with department administrators and knowledgeable faculty to gain anunderstanding of the costs of diagnostic examinations and the influence of thetype of payer system on reimbursement
- ACR/APDR non-interpretive skills videotapes
- Membership and active participation in local and national radiological societies
- Departmental or institutional presentations on health care funding and regulation

Assessment

- Global ratings by faculty
- Written ABR examination
- ACR in-training examination
- Multi-disciplinary conference attendance logs
- Documented membership and participation in radiologic societies and otherhealth care organization.

ROAD MAP OF MD TRAINING DIAGNOSTIC RADIOLOGY:



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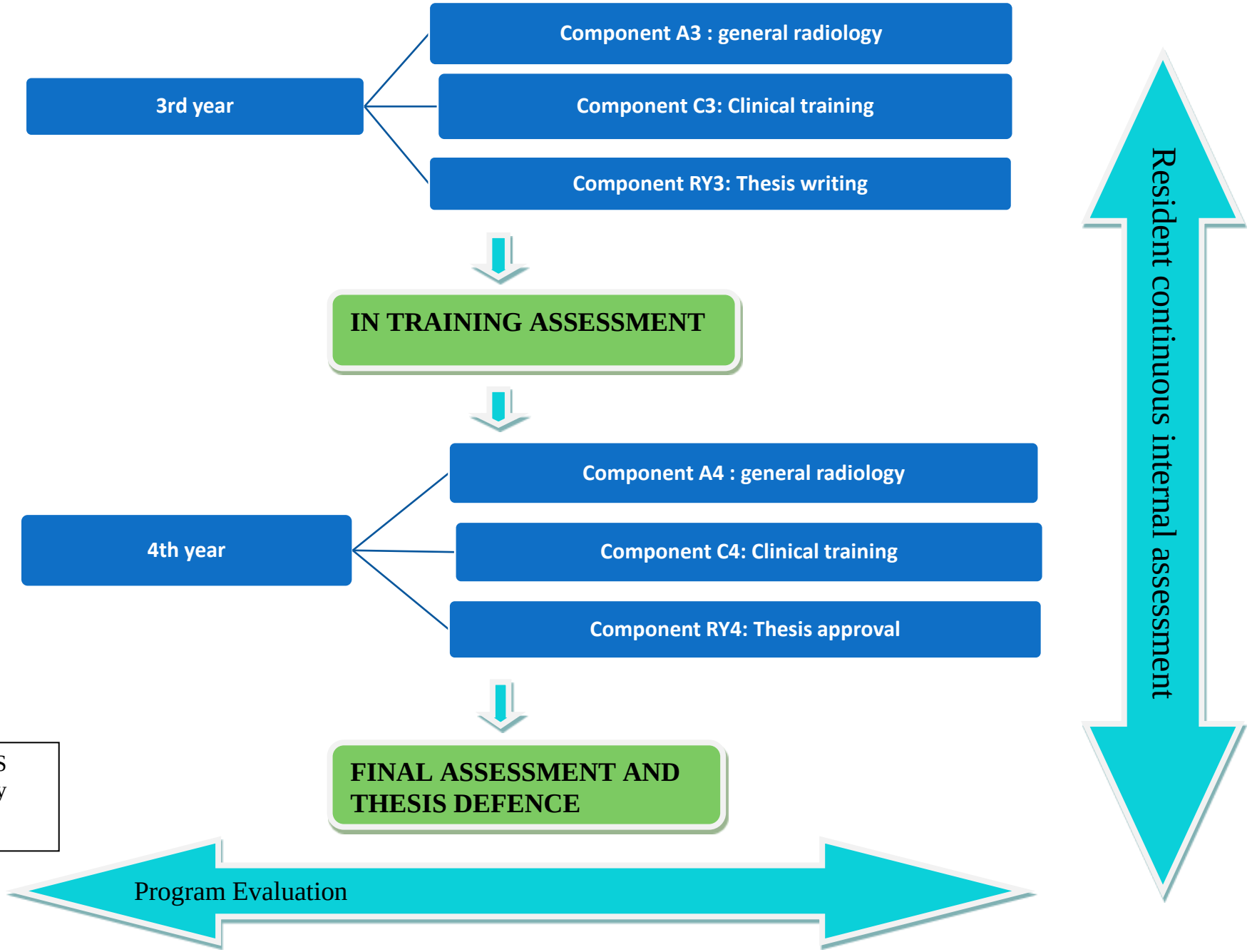


FIG:1 Road Map MS Diagnostic Radiology Program

3. LEARNING OPPORTUNITIES/ MITs:

1. **Reporting sessions:** All residents will have rotations in Radiography, MRI, CT, mammography, Fluoroscopy where respective reporting session will be conducted. The required knowledge and skills pertaining to respective areas shall be demonstrated. All residents will play an active role under supervision of respective fellow.
2. **Hands on training:**Hands on training shall be conducted for Ultrasounds, dopplers, guided aspirations, biopsy procedures, and fluoroscopies where residents shall have active participation to acquire the skills that shall play a significant role in their career ahead.
3. **Journal Club Meeting (JC):**A resident will be assigned to present, in depth, a research article or topic of his/her choice of actual or potential broad interest and/or application. Two hours per month should be allocated to discussion of any current articles or topics introduced by any participant. Faculty or outside researchers will be invited to present outlines or results of current research activities. The article should be critically evaluated and its applicable results should be highlighted, which can be incorporated in clinical practice. Record of all such articles should be maintained in the relevantdepartment
4. **Small Group Discussions/ Problem based learning/ Case based learning:** Traditionally small groups consist of 8-12 participants. Small groups can take on a variety of different tasks, including problem solving, role play, discussion, brainstorming, debate, workshops and presentations. Generally students prefer small group learning to other instructional methods. From the study of a problem students develop principles and rules and generalize their applicability to a variety of situations PBL is said to develop problem solving skills and an integrated body of knowledge. It is a student-centered approach to learning, in which students determine what and how they learn. Case studies help learners identify problems and solutions, compare options and decide how to handle a realsituation.
5. **Discussion/Debate**: There are several types of discussion tasks which would be used as learning method for residents including: guided discussion, in which the facilitator poses a discussion question to the group and learners offer responses or questions to each other's contributions as a means of broadening the discussion's scope; inquiry-based discussion, in which learners are guided through a series of questions to discover some relationship or principle; exploratory discussion, in which learners examine their personal opinions, suppositions or assumptions and then visualize alternatives to these assumptions; and debate in which students argue opposing sides of a controversial topic. With thoughtful and well-designed discussion tasks, learners can practice critical inquiry and reflection, developing their individual thinking, considering alternatives and negotiating meaning with other discussants to arrive at a shared understanding of the issues at hand.

6. **Case Conference (CC)/ Morning Meetings:**These sessions are held once each week; the focus of the discussion is selected by the presenting resident. For example,somecasesmay bepresentedtodiscussadifferentialdiagnosis,whileothersarepresentedto share interesting cases.
7. **Clinico-pathological Conferences:**Theclinico pathological conference, popularly known as CPC primarily relies on case method of teaching medicine. It is a teaching tool that illustrates the logical, measured consideration of a differential diagnosis used to evaluate patients. The process involves case presentation, diagnostic data, discussion of differential diagnosis, logically narrowing the list to few selected probable diagnoses and eventually reaching a final diagnosis and its brief discussion. The idea was first practiced in Boston, back in 1900 by a Harvard internist, Dr. Richard C. Cabot who practiced this as an informal discussion session in his private office. Dr. Cabot incepted this from a resident, who in turn had received the idea from a roommate, primarily a lawstudent.
8. **Directly Supervised Procedures - (DSP*)*:** Residents learn procedures under the direct supervision of an attending or fellow during some rotations.
9. **Self-directed learning s**elf-directed learning residents have primary responsibility for planning, implementing, and evaluating their effort. It is an adult learning technique that assumes that the learner knows best what their educational needs are. The facilitator's role in self- directed learning is to support learners in identifying their needs and goals for the program, to contribute to clarifying the learners' directions and objectives and to provide timely feedback. Self-directed learning can be highly motivating, especially if the learner is focusing on problems of the immediate present, a potential positive outcome is anticipated and obtained and they are not threatened by taking responsibility for their ownlearning.
10. **Audio visual laboratory*:***audio visual material for teaching skills to the residents is used specifically in teaching ultrasound and interventional proceduredetails.
11. **E-learning/web-based medical education/computer-assisted instruction:**Computertechnologies, including the Internet, can support a wide range of learning activities from dissemination of lectures and materials, access to live or recorded presentations, real-time discussions, self-instruction modules and virtual patient simulations. distance-independence, flexible scheduling, the creation of reusable learning materials that are easily shared and updated, the ability to individualize instruction through adaptive instruction technologies and automated record keeping for assessmentpurposes.
12. **Research based learning*:***All residents in the categorical program are required to complete an academic outcomes-based research

project during their training. This project can consist of original bench top laboratory research, clinical research or a combination of both. The research work shall be compiled in the form of a thesis which is to be submitted for evaluation by each resident before end of the training. The designated Faculty will organize and mentor the residents through the process, as well as journal clubs to teach critical appraisal of the literature.

SECTION 5: RESEARCH & THESIS WRITING

Research and Thesis have to be completed during training period. Research topic selection is must in first year. Synopsis writing and approval from IRF & BASR are must in second year of training. In third year of training Thesis should be written, while in first six months of fourth year Thesis should be completed and after appropriate defense it should be approved by BASR.

Research Experience & Workshops:

The active research component program must ensure meaningful, supervised research experience with appropriate protected time for each resident while maintaining the essential clinical experience. Residents must learn the design and interpretation of research studies, responsible use of informed consent, and research methodology and interpretation of data. The program must provide instruction in the critical assessment of new therapies and of the medical literature. Residents will be advised and supervised by qualified staff members in the conduct of research
To help conduction of Research and facilitate Thesis writing following workshops are mandatory during training that will be organized by RMU:

- Communication skills
- Computer & IT skills days
- Synopsis writing
- Research Methodology & Biostatistics
- Reference Manager (Endnote)

Clinical Research

Each resident will participate in at least one clinical research study to become familiar with

1. Research design
2. Research involving human subjects including informed consent and operations of the Institutional Review Board and ethics of human experimentation
3. Data collection and data analysis
4. Research ethics and honesty

5. Peer review process

This usually is done during the consultation and outpatient clinic rotations.

Thesis

The candidates shall prepare their synopsis as per guidelines provided by Institutional Research Forum/Ethical Review Board (IRF/ERB) and Board of Advanced Studies & Research (BASR). The research topic must consist of a reasonable sample size and sufficient numbers of variables to give training to the candidate to conduct research, collect and analyze data. Synopsis of research project should be approved in 2nd year of MS programby IRF/ERB and BASR. In 3rd year Thesis work should be completed, and in 4th year it should be approved from BASR.

SECTION 6: ASSESSMENT:

1 Purpose of assessment:

Assessment of learning is an essential component of any curriculum. The focus is ongood practice, basedon fair and robustassessment principles and processes in order to ensure a positive educational impact on learnersand to support assessors in making valid and reliable judgements. The program of assessmentcomprisesanintegratedframeworkofexaminations,assessmentsintheworkplaceandjudgements made about a learner during their approved program of training. Its purpose is to robustlyevidence,ensureandclearlycommunicatetheexpectedlevelsofperformanceatcriticalprogression points in, and to demonstrate satisfactory completion of, training as required by thecurriculum.

Assessments can be described as *helping* learning or *testing* learning - referred to as formative andsummative respectively. There is a link between the two; some assessments are purely formativeothers are explicitly summative with a feedback element whileothersprovideformativefeedbackwhilecontributingtosummativeassessmentas in Continuous Internal Assessment (CIA).

Thepurposesof**formativeassessment**areto:

- assesstrainees'actualperformanceintheworkplace.
- enhance learning by enabling trainees to receive immediate feedback, understand their ownperformanceandidentify areas fordevelopment.
- drive learning and enhance the training process by making it clear what is required of traineesandmotivatingthemtoensuretheyreceive suitabletrainingandexperience.
- enablesupervisorstoreflectontraineeneedsinordertotailortheirapproachaccordingly.

Thepurposesof**summativeassessment**areto:

- provide robust, summative evidence that trainees are meeting the curriculum requirementsduringthetrainingprogramme.
- ensure that trainees possess the essential underlying knowledge required for their specialty.
- identifytraineeswhoshouldbeadvisedto considerchangesofcareerdirection.
- provideinformationforthequalityassuranceofthecurriculum.

2 Assessment Methods:

Workplace-based assessment (WBA):

Each individual WBA is designed to assess a range of important aspects of performance in differenttraining situations. Taken together the WBAs can assess the breadth of knowledge, skills andperformance described in the curriculum.EachWBAisrecordedonastructuredformtohelpassessorsdistinguishbetweenlevelsofperformance and prompt areas for their verbal developmental feedback to trainees immediatelyafter the observation.

WBAsareformativeandmaybeusedtoassessandprovidefeedbackonallclinicalactivity.Traineescan use any of the assessments described below to gather feedback or provide evidence of theirprogression in a particular area. WBAs are only mandatory for the assessment ofthe criticalconditions and index procedures.

a) CaseBasedDiscussion(CBD)

TheCBDassessestheperformanceofatraineeintheirmanagementofapatientcasetoprovideanindication of competence in areas such as clinical judgement, decision-making and application ofmedical knowledge in relation to patient care. The CBD process is a structured, in-depth discussionbetweenthetraineeandaconsultantsupervisor.Themethodisparticularlydesignedtotesthigherorder thinking and synthesis as it allows the assessor to explore deeper understanding of howtrainees compile, prioritize and apply knowledge. By using clinical cases that offer a challenge totrainees, rather than routine cases, trainees are able to explain the complexities involved and thereasoningbehindchoicestheymade.Italsoenablesthediscussionoftheethicalandlegalframework of practice. Astheactualrecordisthefocus forthediscussion,theassessorcanalso evaluate the quality of record keeping and the presentation of cases. The CBD is important forassessing the critical conditions) Trainees are assessed against the standard for thecompletionoftheirphaseoftraining.

b) Clinical Evaluation Exercise (CEX) / CEX for Consent (CEX(C))

TheCEXorCEX(C)assessesaclinicalencounterwithapatienttoprovideanindicationofcompetenceinskillsessentialforgoodclinicalcaresuchascom munication,historytaking,examination and clinical reasoning. These can be used at any time and in any setting when there isa trainee and patient interaction and an assessor is available. The CEX or CEX(C) is important forassessing the critical conditions. Trainees are assessed against the standard for thecompletionoftheirphaseoftraining.

c) Direct Observation of Procedural Skills (DOPS)

The DOPS assesses the trainee's technical, operative and professional skills in a range of basicdiagnosticandinterventionalproceduresduringroutinesurgicalpracticeinwards,outpatientclinicsand operating theatres. The procedures reflect the common and important procedures. Traineesare assessedagainstthestandardforthe completionof coresurgicaltraining.

d) Multi-source Feedback (MSF)

TheMSFassessesprofessionalcompetencewithinateamworkingenvironment.Itcomprisesaself-assessment and the assessments of the trainee's performance from a range colleagues coveringdifferentgradesandenvironments(e.g.ward,theatre,out-patients). Feedback is in the form of a peer assessment chart, enabling comparison of the self-assessment with the collated views received from the team and includes their anonymized butverbatim written comments. The supervisor should meet with the trainee to discuss the feedback onperformance in the MSF. Trainees are assessed against the standard for the completion of theirtraininglevel.

e) Procedure Based Assessment (PBA)

The PBA assesses advanced technical, operative and professional skills in a range of specialtyprocedures or parts of procedures during routine surgical practice in which trainees are usuallyscrubbed in theatre. The assessment covers pre-operative planning and preparation; exposure andclosure; intra-operative elements specific to each procedure and post-operative management. Theprocedures reflect the routine or index procedures relevant to the specialty. The PBA is usedparticularlytoassesstheindexprocedures.Traineesareassessedagainstthestandards

f) Logbook

The logbook is tailored to each specialty and allows the trainee's competence as assessed by theDOPS and PBA to be placed in context. It is not a formal assessment in its own right, but traineesare required to keep a log of all operative procedures they have undertaken including the level ofsupervision required on each occasion using the key below. The logbook demonstrates breadth ofexperience which can be compared with procedural competence using the DOPS and the PBA andwill be compared with the indicative numbers of index proceduresdefined in the curriculum.

g) **Portfolio**

A portfolio is a collection of products prepared by the resident that provides evidence of learning and achievement related to a learning plan. A portfolio typically contains written documents but can include video- or audio-recordings, photographs, and other forms of information. Reflecting upon what has been learned is an important part of constructing a portfolio. In addition to products of learning, the portfolio can include statements about what has been learned, its application, remaining learning needs, and how they can be met. In graduate medical education, a portfolio might include a log of clinical procedures performed; a summary of the research literature

reviewed when selecting a treatment option; a quality improvement project plan and report of results; ethical dilemmas faced and how they were handled; a computer program that tracks patient care outcomes; or a recording or transcript of counseling provided to patients. Portfolios can be used for both formative and summative evaluation of residents. Portfolios are most useful for evaluating mastery of competencies that are difficult to evaluate in other ways such as practice-based improvement, use of scientific evidence in patient care, professional behaviors, and patient advocacy. Teaching experiences, morning report, patient rounds, individualized study or research projects are examples of learning experiences that lend themselves to using portfolios to assess residents.

h) Observation of Teaching (OoT)

TheOoTassessesthetrainee'sabilitytoprovideformalteaching.Itcanbebasedonanyinstanceofformalizedteachingbythetraineewhichhasbeenobservedbytheassessor.Traineesareassessedagainstthestandardforthecompletionoftheirphaseoftraining.

Written/Oral Assessments:

a) Objective Structured Clinical Examination (OSCE)

Objective Structured Clinical Examination (OSCE)will be held on the first day of the examination, for all the candidates declared eligible for clinical part of the relevant examination. Candidates will be sent information regarding the schedule of OSCE by the Examination Department. In the OSCE the candidates will be evaluated on procedures, x-rays, clinical history & laboratory findings, instruments, cross sectional imaging etc. This component of examination will consist of 15 to 20 stations, 4-8 minutes per station arranged in the examination hall and the candidates will have to rotate through all of them in turn.

The OSCE stations will be of two types:

l. Observed /Interactive

II. Unobserved / Static.

b) MCQ:

A written or computer-based MCQ examination is composed of multiple-choice questions (MCQ) selected to sample medical knowledge and understanding of a defined body of knowledge, not just factual or easily recalled information. Each question or test item contains an introductory statement followed by four or five options in outline format. The examinee selects one of the options as the presumed correct answer by marking the option on a coded answer sheet. Only one option is key to the correct response. The introductory statement often presents a patient case, clinical findings, or displays data graphically. A separate booklet can be used to display pictures, and other relevant clinical information. In computer-based examinations the test items are displayed on a computer monitor on eat a time with pictures and graphical images also displayed directly on the monitor. In a computer-adaptive test fewer test questions are needed because test items are selected based upon statistical rules programmed into the computer to quickly measure the examinee's ability. Medical knowledge and understanding can be measured by MCQ examinations. Comparing the test scores on in-training examinations with national statistics can serve to identify strengths and limitations of individual residents to

help them improve. Comparing test results aggregated for residents in each year of a program can be helpful to identify residency training experiences that might be improved.

c) **Short-answer questions**

Short-answer questions are open-ended questions that require students to create an answer. They are commonly used in examinations to assess the basic knowledge and understanding of a topic before more in-depth assessment questions are asked on the topic. It is very important that the assessor is very clear on the type of answers expected when setting the questions, because SAQ is an open-ended questions, students are free to answer any way they choose, short-answer questions can lead to difficulties in grading if the question is not worded carefully.

d) Viva Voce

3 Assessment Scheme:

FIRSTINTRAININGASSESSMENT **At the endof1st YearTraining**	MID-TERM ASSESSMENT **At the end of 2nd year Training**	THIRD IN TRAINING ASSESSMENT **At the end of 3rd year Training**	FINAL ASSESSMENT **At the end of 4th year Training**
• **Written Paper**	• **Written &OSCE**	• **Written Paper**	• **Written, Clinical, And Thesis -**
Total Marks= 100	**Total Marks =300**	**Total Marks= 100**	**Total Marks= 800**
MCQ=100 clinically based	**a) Written-Twopapers** Twopapers each of 75scenariobasedMCQs 75+75=150 marks **(Pass%=60%)-eligibility for clinical assessment** **b) OSCE** -150marks	**MCQs**=100 clinically based	**a) Written- Two papers** • 1st paper- 100 MCQs-100 marks • 2nd paper- 10 SEQs-100 marks **(Pass%=60%)-eligibility for clinical assessment** **b) Clinical** • OSCE – 300 marks • Viva Voce- 200 marks **(Pass%=60%)** **c) Thesis- 100 marks**
Pass Percentage = 50%	**Pass percentage = 60%**	**Pass percentage = 50%**	**Pass percentage = 60%**

4 Eligibility Criteria:

First In Training Assessment	Mid-Term Assessment	Third In Training Assessment	Final Assessment
Certificate ofCompletion of 1st year training. **Rotations completion:** Nuclear medcine-6weeks Workshops completion: • Communication skills- 3 days • Computer & IT skills- 3 days • Synopsis writing -3 days • Research methodology & Biostatistics-3 days **Research:** • Allotment of Synopsis topic by supervisor • Publication of one article in Resident Research Journal OR Statistical report of one disease **CIA:**Minimum 75% marks Certification by DME and Supervisor/s	**Certificate of completion of 2nd year training.** **Passed First In Training Assessment** **Rotations completion:** Interventional radiology-1 months MRI I– 2 months **Research:** Formulation of research Synopsis with approval of IRF & BASR by the end of 2nd year. **CIA:** Minimum 75% marks Certification by DME and Supervisor/s	**Certificate of completion of 3rdyear training.** **Passed Mid-term Assessment** **Rotations completion:** Echo- 2weeks MRI II- 2 months **Research:** Data collection Data analysis & interpretation Start writing Thesis **CIA**: Minimum 75% marks Certificationby DME and Supervisor/s	**Certificate of completion of 4th year training** **Passed Third In Training Assessment** **Rotations completion:** Interventional radiology-1 months **Research/Thesis**: • Completion & submission of Thesis 6 months before completion of training • Defense & Approval of Thesis in BASR •Publication of one article in Resident Research Journal OR Statistical report of one disease **CIA:**Minimum 75% marks Certification by DME and Supervisor/s **FEE:** Evidence of submission of examination fee **No dues certificate:** submitted from all relevant departments including

Final Assessment Schedule and Fee:

a. Final Assessment will be held twice a year.
b. The candidates have to fulfil eligibility criteria before permission is granted to take the assessment.
c. Assessment fee will be determined and varied at periodic intervals by the University.
d. The Assessment fee once deposited cannot be refunded / carried over to the next assessment under any circumstances.

e. The Controller of Examinations will issue an Admittance Card with a photograph of the candidate on receipt of prescribed application form, documents satisfying eligibility criteria and evidence of payment of assessment fee. This card will also show the Roll Number, date / time and venue of assessment.
f. The written part of assessment will be valid for three consecutive attempts for appearing in the Clinical and Oral Part of the Final Assessment. After that the candidates have to re-sit the written part of the Final Assessment.
g. The candidates will have two attempts to pass the final examination with normal fee. A special administration fee of Rs.10, 000 in addition to normal fee or the amount determined by the University from time to time shall be charged for further attempts

Clinical Examination: OSCE & ORAL:

MID TERM EVALUATION

a. The OSCE part of MID term evaluation will consist of 15 Stations of radiological physics, radiological anatomy, and basic radiology with 50 percent stations being static and 50% being interactive. Each station carrying 10 marks and of 05 minute duration.

FINAL EVALUATION

a) The OSCE of final evaluation will consist of 30 slides displayed for 5 minutes each.
b) The oral viva stations to be taken by examiners as decided by examiners panel.
c) Viva will be 03 stations (2 units each). Each viva station will be of **20 minutes** duration, **for 7 films in each station**.

b. Panel of four examiners will be appointed by the Vice Chancellor and of these two will be from RMU whilst the other two will be the external examiners. Internal examiner will act as a coordinator. ln case of difficulty in finding an Internal examiner arrange given subject, the Vice Chancellor would, in consultation with the concerned Deans, appoint any relevant person with appropriate qualification and experience, outside the University as an examiner.
c. The internal examiners will not examine the candidates for whom they have acted as Supervisor and will be substituted by other internal examiner.
d. The candidates scoring 50% marks In each component of the Clinical & Oral Examination will pass this part of the Final Examination.

Continuous Internal Assessments (CIA): 75%

Continuous Internal Assessments would be submitted by the supervisor considering the following:

A. Workplace Based Assessments: These assessments will include the following:
- Generic and Specialty specific Competency Assessments
- Multisource Feedback Evaluation

B. Assessment of Residents' Training Log Book & Portfolio

Declaration of Result:

For the declaration of result

1. The Resident must get his/her Thesis accepted.
2. The Resident must have passed the final written examination with 50% marks and the clinical & oral examination securing 50% marks. The cumulative passing score from the written and clinical/ oral examination shall be 60%. Cumulative score of 60% marks to be calculated by adding up secured marks of each component of the Examination i.e., written and clinical & oral and then calculating its percentage.
3. The MS degree shall be awarded after acceptance of thesis and success in the final examination.
4. On completion of stipulated training period, irrespective of the result (pass or fail) the training slot of the candidate shall be declared vacant.

Submission / Evaluation of Synopsis

a. The Residents shall prepare their synopsis as per guidelines provided by the Board of Advanced Studies & Research, available on university website.
b. The research topic in clinical subject should have 30% component related to basic sciences and 70% component related to applied clinical sciences. The research topic must consist of a reasonable sample size and sufficient numbers of variables to give training to the candidate to conduct research, to collect & analyze the data.
c. Synopsis of research project shall be got approved by the end of the 2nd year of MD program. The synopsis after review by an Institutional Review Committee shall be submitted to the University for Consideration by the Board of Advanced Studies & Research, through the Principal / Dean /Head of the institution.

Submission of Thesis

1. Thesis shall be submitted by the candidate duly recommended by the Supervisor.
2. The minimum duration between approval of synopsis and submission of thesis shall be one year.
3. The research thesis must be compiled and bound in accordance with the Thesis Format Guidelines approved by the University and available on website.
4. The research thesis will be submitted along with the fee prescribed by the University.

Thesis Evaluation

a. The Resident will submit his/her thesis at least O6 months prior to completion of training.
b. The Thesis along with a certificate of approval from the supervisor will be submitted to the Registrar's office, who would record the date / time etc. and get received from the Controller of Examinations within 05 working days of receiving.
c. The Controller of Examinations will submit a panel of eight assessors within 07 days for selection of four examiners by the Vice Chancellor. The Vice Chancellor shall return the Final panel within 05 working days to the Controller of Examinations for processing and assessment. In case of any delay the Controller ofExamination would bring the case personally to the Vice Chancellor.
d. The Supervisor shall not act as an examiner of the candidate and will not take part in defence of thesis.
e. The Controller of Examinations will make sure that the Thesis is submitted to examiners in appropriate fashion and a reminder is sent after every ten days.
f. The thesis will be evaluated by the examiners within a period of 06 weeks.
g. In case the examiners fail to complete the task within 06 weeks with 02 fortnightly reminders by the Controller of Examinations, the Controller of Examinations will bring it to the notice of Vice Chancellor in person.
h. In case of difficulty in find an internal examiner for thesis evaluation, the Vice Chancellor would, in consultation with the concerned Deans, appoint any relevant person as examiner in supersession of the relevant Clause of the University Regulations.
i. There will be two internal and two external examiners. In case of difficulty in finding examiners, the Vice Chancellor would, in consultation with the concerned Deans, appoint minimum of three, one internal and two external examiners.
j. The total marks of thesis evaluation will be 100 and 60% marks will be required to pass the evaluation.
k. The thesis will be considered accepted, if the cumulative score of all the examiners is 60%.

l. The clinical training will end at completion of stipulated training period but the candidate will become eligible to appear in the Final Examination at completion of clinical training and after acceptance of thesis.In case clinical training ends earlier, the slot will fall vacant after stipulated training period.

Award of MD DIAGNOSTIC RADIOLOGYDegree

After successful completion of the structured course of MD DIAGNOSTIC RADIOLOGY and qualifying Mid-term, Final Assessment (Written, Clinical: ORAL and Thesis), the degree with title MD DIAGNOSTIC RADIOLOGY Degreeshall be awarded.

SECTION 7: CURRICULUM EVALUATION:

Curriculum evaluation is an important part of curriculum development. Two basic stages of curriculum evaluation are process evaluation and product evaluation. Most important aim is to evaluate if the main goals or objective have been met in order to understand and make further improvements to the curriculum.

APPENDIX 1:

DIAGNOSTIC RADIOLOGY MILESTONES
ACGME REPORT WORKSHEET

Patient Care and Technical Skills (Residents must be able to meet previous year milestones when evaluated at a specific level)

PCTS1: Consultant					
Has not Achieved Level 1	**Level 1**	**Level 2**	**Level 3**	**Level 4**	**Level 5**
	Uses established evidence-based imaging guidelines such as American College of Radiology (ACR) Appropriateness Criteria* Appropriately uses the Electronic Health Record to obtain relevant clinical information	Recommends appropriate imaging of common* conditions independently *As defined by the residency program	Recommends appropriate imaging of uncommon* conditions independently *As defined by the residency program	Integrates current research and literature with guidelines, taking into consideration cost effectiveness and risk-benefit analysis, to recommend imaging	Participates in research, development, and implementation of imaging guidelines
☐	☐	☐	☐	☐	☐
Comments:					

Possible Methods of Assessment/Examples:

- 360 Evaluation/Multi-rater/Peer
- Direct observation and feedback
- End-of-Rotation Global Assessment
- Self-Assessment and Reflections/Portfolio
- End-of-Year Examination

- Simulation/OSCE

Patient Care and Technical Skills

PCTS2: Competence in procedures					
Has not Achieved Level 1	**Level 1**	**Level 2**	**Level 3**	**Level 4**	**Level 5**
	Competently performs basic procedures* under indirect supervision Recognizes and manages complications of basic procedures *Basic procedures, as defined by each residency program, include those needed to take independent call	Competently performs intermediate procedures, as defined by the residency program Recognizes and manages complications of intermediate procedures	Competently performs advanced procedures, as defined by the residency program Recognizes and manages complications of advanced procedures	Able to competently and independently perform the following procedures: • adult and pediatric fluoro studies • lumbar puncture • image-guided venous and arterial access • hands-on adult and pediatric ultrasound studies • drainage of effusions and abscesses • image-guided biopsy • nuclear medicine I-131 treatments (≤ 33 and > 33 mCi)	Able to teach procedures to junior-level residents Competently performs complex procedures, modifies procedures as needed, and anticipates and manages complications of complex procedures
☐	☐	☐	☐	☐	☐
Comments:					

Possible Methods of Assessment/Examples:
- 360 Evaluation/Multi-rater/Peer
- End-of-Rotation Global Assessment
- Case/Procedure Logs, including complications

- Direct observation and feedback
- Procedural competency checklists
- Self-Assessment and Reflections/Portfolio
- Simulation/OSCE

Medical Knowledge

MK1: Protocol selection and optimization of images					
Has not Achieved Level 1	**Level 1**	**Level 2**	**Level 3**	**Level 4**	**Level 5**
	Selects appropriate protocol and contrast agent/dose for basic imaging, including protocols encountered during independent call as defined by the residency program Recognizes sub-optimal imaging	Selects appropriate protocols and contrast agent/dose for intermediate imaging as defined by the residency program	Selects appropriate protocols and contrast agent/dose for advanced imaging as defined by the residency program Demonstrates knowledge of physical principles to optimize image quality	Independently modifies protocols as determined by clinical circumstances Applies physical principles to optimize image quality	Teaches and/or writes imaging protocols
☐	☐	☐	☐	☐	☐
Comments:					

Possible Methods of Assessment/Examples:
- End-of-Rotation Global Assessment
- Direct observation and feedback
- Self-Assessment and Reflections/Portfolio

- Core exam
- OSCE/simulation

Medical Knowledge

MK2: Interpretation of examinations					
Has not Achieved Level 1	**Level 1**	**Level 2**	**Level 3**	**Level 4**	**Level 5**
	Makes core observations, formulates differential diagnoses, and recognizes critical findings Differentiates normal from abnormal	Makes secondary observations, narrows the differential diagnosis, and describes management options	Provides accurate, focused, and efficient interpretations Prioritizes differential diagnoses and recommends management	Makes subtle observations Suggests a single diagnosis when appropriate Integrates current research and literature with guidelines to recommend management	Demonstrates expertise and efficiency at a level expected of a subspecialist Advances the art and science of image interpretation
☐	☐	☐	☐	☐	☐
Comments:					

Possible Methods of Assessment/Examples:
- End-of-Rotation Global Assessment
- Direct observation and feedback

- Reading out with resident
- ER preparedness test
- Review of reports
- Rate of major discrepancies
- Core exam

Professionalism:

PROF1: Professional Values and Ethics					
Has not Achieved Level 1	**Level 1**	**Level 2**	**Level 3**	**Level 4**	**Level 5**
	Demonstrates the following professional behaviors: • recognizes the importance and priority of patient care and advocates for patient interests • fulfills work-related responsibilities • is truthful • recognizes personal limitations and seeks help when appropriate • recognizes personal impairment and seeks help when needed • responds appropriately to constructive criticism • places needs of patients before self • maintains appropriate boundaries with patients, colleagues, and others • exhibits tolerance and acceptance of diverse individuals and groups • maintains patient confidentiality • fulfills institutional and program requirements related to professionalism and ethics • attends required	Is an effective health care team member Demonstrates professional behaviors listed in the second column	Is an effective health care team leader, promoting primacy of patient welfare, patient autonomy, and social justice Demonstrates professional behaviors listed in the second column	Serves as a role model for professional behavior Demonstrates professional behaviors listed in the second column	Participates in local and national organizations to advance professionalism in radiology Mentors others regarding professionalism and ethics

	conferences									
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Comments:										

Possible Methods of Assessment/Examples:

- End-of-Rotation Global Assessment
- 360 Evaluation/Multi-rater/Peer
- Simulation/OSCE
- Direct observation and feedback
- Conference attendance logs
- Timeliness in completing institutional and program requirements

Interpersonal and Communication Skills

ICS1: Effective communication with patients, families, and caregivers					
Has not Achieved Level 1	**Level 1**	**Level 2**	**Level 3**	**Level 4**	**Level 5**
	Communicates information about imaging and examination results in routine, uncomplicated circumstances Obtains informed consent	Communicates, under direct* supervision, in challenging circumstances (e.g., cognitive impairment, cultural differences, language barriers, low health literacy) Communicates, under direct supervision, difficult information such as errors, complications, adverse events, and bad news *see ACGME definition of direct supervision in the Program Requirements	Communicates, under indirect* supervision, in challenging circumstances (e.g., cognitive impairment, cultural differences, language barriers, low health literacy) *see ACGME definition of direct supervision in the Program Requirements	Communicates complex and difficult information, such as errors, complications, adverse events, and bad news	Serves as a role model for effective and compassionate communication Develops patient-centered educational materials
☐	☐	☐	☐	☐	☐
Comments:					

Possible Methods of Assessment/Examples:

- End-of-Rotation Global Assessment
- 360 Evaluation/Multi-rater/Peer
- Simulation/OSCE
- Direct observation and feedback
- Self-Assessment and Reflections/Portfolio

Interpersonal and Communication Skills

ICS2: Effective communication with members of the health care team					
Has not Achieved Level 1	**Level 1**	**Level 2**	**Level 3**	**Level 4**	**Level 5**
	Adheres to transfer-of-care policies **Written/Electronic:** Generates accurate reports with appropriate elements required for coding **Verbal:** Communicates urgent and unexpected findings according to institutional policy and ACR guidelines	**Written/Electronic:** Efficiently generates clear and concise reports that do not require substantive faculty member correction on routine cases **Verbal:** Communicates findings and recommendations clearly and concisely	**Written/Electronic:** Efficiently generates clear and concise reports that do not require substantive faculty member correction on common complex cases **Verbal:** Communicates appropriately under stressful situations	**Written/Electronic:** Efficiently generates clear and concise reports that do not require substantive faculty member correction on all cases **Verbal:** Communicates effectively and professionally in all circumstances	Leads interdisciplinary conferences **Written/Electronic:** Generates tailored reports meeting needs of referring physician Develops templates and report formats **Verbal:** Serves as a role model for effective communication
☐	☐	☐	☐	☐	☐
Comments:					

Possible Methods of Assessment/Examples:

- End-of-Rotation Global Assessment
- 360 Evaluation/Multi-rater/Peer
- Simulation/OSCE (Intradepartmental and Team)
- Direct observation and feedback
- Self-Assessment and Reflections/Portfolio

Systems-based Practice

SBP1: Quality Improvement (QI)					
Has not Achieved Level 1	**Level 1**	**Level 2**	**Level 3**	**Level 4**	**Level 5**
	Describes departmental QI initiatives Describes the departmental incident/occurrence reporting system	Incorporates QI into clinical practice Participates in the departmental incident/occurrence reporting system	Identifies and begins a systems-based practice project incorporating QI methodology	Completes a systems-based practice project as required by the ACGME Review Committee Describes national radiology quality programs (e.g., National Radiology Data Registry, accreditation, peer-review)	Leads a team in the design and implementation of a QI project Routinely participates in root cause analysis
☐	☐	☐	☐	☐	☐
Comments:					

Possible Methods of Assessment/Examples:

- End-of-Rotation Global Assessment
- 360 Evaluation/Multi-rater/Peer
- Direct observation and feedback
- Self-Assessment and Reflections/Portfolio
- Semi-annual evaluation with program director
- Written feedback on project (with mentor)

- Project presentation feedback (faculty, peers, others in system)
- Critical incidents reporting and feedback

Practice-based Learning and Improvement

PBLI1: Patient safety: contrast agents; radiation safety; MR safety; sedation					
Has not Achieved Level 1	**Level 1**	**Level 2**	**Level 3**	**Level 4**	**Level 5**
	Contrast Agents: Recognizes and manages contrast reactions **Radiation Safety:** Describes the mechanisms of radiation injury and the ALARA ("as low as reasonably achievable") concept **MR Safety:** Describes risks of MRI	**Contrast Agents:** Re-demonstrates recognition and management of contrast reactions **Radiation Safety:** Accesses resources to determine exam-specific average radiation dose information **MR Safety:** Accesses resources to determine the safety of implanted devices and retained metal	**Contrast Agents:** Re-demonstrates recognition and management of contrast reactions **Radiation Safety:** Communicates the relative risk of exam-specific radiation exposure to patients and practitioners **MR Safety:** Communicates MR safety of common implants and retained foreign bodies to patients and practitioners	**Contrast Agents:** Re-demonstrates recognition and management of contrast reactions **Radiation Safety:** Applies principles of Image Gently® and Image Wisely® **MR Safety:** Applies principles of MR safety including safety zones and pre-MR screening **Sedation**: Describes the principles of conscious sedation	**Contrast Agents:** Teaches appropriate treatment of contrast reactions **Radiation Safety:** Promotes radiation safety **MR Safety:** Participates in establishing or directing a safe MR program **Sedation**: Selects appropriate sedation agent and dose for conscious sedation
☐	☐	☐	☐	☐	☐
Comments:					

Possible Methods of Assessment/Examples:

- End-of-Rotation Global Assessment
- 360 Evaluation/Multi-rater/Peer
- Simulation/OSCE
- Direct observation and feedback
- Self-Assessment and Reflections/Portfolio

- Completion of institutional safety modules, BCLS/ACLS

Practice-based Learning and Improvement

PBLI2: Self-Directed Learning					
Has not Achieved Level 1	**Level 1**	**Level 2**	**Level 3**	**Level 4**	**Level 5**
	Develops an annual learning plan based on self-reflection and program feedback	Evaluates and modifies learning plan	Evaluates and modifies learning plan	Evaluates and modifies learning plan	Advocates for lifelong learning at local and national levels
☐	☐	☐	☐	☐	☐
Comments:					

Possible Methods of Assessment/Examples:
- End-of-Rotation Global Assessment
- Semi-annual evaluation meeting with program director
- Self-Assessment and Reflections/Portfolio
- Resident teaching and feedback
- Core exam

Practice-based Learning and Improvement

PBLI3: Scholarly activity					
Has not Achieved Level 1	**Level 1**	**Level 2**	**Level 3**	**Level 4**	**Level 5**
	Documents training in critical thinking skills and research design	Works with faculty mentors to identify potential scholarly projects	Begins scholarly project	Completes and presents a scholarly project	Independently conducts research and contributes to the scientific literature and/or completes more than one scholarly project Completes an IRB submission
☐	☐	☐	☐	☐	☐
Comments:					

Possible Methods of Assessment/Examples:

- End-of-Rotation Global Assessment
- Self-Assessment and Reflections/Portfolio
- Core exam
- Journal club discussions
- Written feedback on project (with mentor)
- Project presentation feedback (faculty, peers, others in system)
- Completion of AJR Self-Assessment Modules or CITI modules

APPENDIX 2:DIAGNOSTIC RADIOLOGY COURSE

DETAILS OF M.D. (DIAGNOSTICRADIOLOGY) COURSE

- This training represents first opportunity to learn and acquire radiological skills.
- Be familiar with:
    - Concepts and terminology of diagnostic radiology
    - Radiological and radiographic techniques and procedures
    - Communication, interpretation and report writing
- The specialty of clinical radiology involves all aspects of medical imaging that provide information about anatomy, function and disease states.

SYSTEM – BASED SUBSPECIALTIES:

- Breast imaging
- Cardiac imaging
- Gastrointestinal imaging
- Head and Neck imaging including ear, nose and throat
- Muscular skeleton and trauma imaging
- Neuro Radiology
- Obstetric imaging
- Gynecological imaging
- Thoracic imaging
- Uro Radiology
- Vascular imaging

TECHNIQUE – BASED SUBSPECIALTIES:

C.T. MRI, USG Interventional Radiology and Radionuclide Radiology

DISEASE – BASED SUBSPECIALTY:

- Oncological imaging

AGE- BASED SUBSPECIALTY:

Pediatric imaging

ADVANCED PROFESSIONAL EDUCATION IN RADIOLOGY (THEORY AND SKILLS):

The aim of the curriculum Content is to produce well-trained competent clinical radiologists.

A. PHYSICS:

INTRODUCTION:

General properties of radiation and matter, fundamentals of nuclear physics and radioactivity. Structure of the atom. Definition of atomic number, mass number nuclide, isotope and electron volt.

ELECTROMAGNETIC RADIATION:

Spectrum, general properties, wave and quantum theories.

RADIOACTIVITY:

Exponential decay, specific activity, physical biological and effective half- life, properties of radioactive materials, radioactive decay schemes, units of activity, half-life, properties of radiations 0 alpha, beta, gamma, basic knowledge of reactors.

PRODUCTION OF X-RAYS:

Principles, essential components of X-ray tubes, continuous spectra, characteristic radiation, Factors controlling the nature of X-ray emission.

TUBE RATING:

Stationary and rotating anodes, heat capacity, methods of cooling, effect of focal spot size, exposure time, voltage wave form, multiple exposures, failing load operation, exposure timers, automatic exposure control

INTERACTION:

Interaction of x-rays and gamma rays with matter and their effects on the irradiated materials. Interaction processes and their relative importance for various materials and at different radiation energies. Attenuation, absorption scatter, exponential law, attenuation coefficients, half – value thickness. Homogenous and heterogeneous radiation contrast.

EFFECT:

Heat, excitation, ionization range of secondary electrons, chemical, photographic, fluorescent, phosphorescent, thermo luminescent.

MEASUREMENT OF X-RAY AND GAMMA RAYS:

Quantity: ionization, TLD, and photographic dosimetry.
Exposure: absorbed dose, and the relationship between them and radiation energy
Exposure and exposure rate meters. Geiger – Muller and scintillation detectors
Radionuclide detection measurement. Counting statistics
Quality: radiation, beam energy, mean, effective and peak energy, half value thickness and filtration

INTERACTION OF X-RAYS WITH THE PATIENT:

Attenuation in various body tissues, high voltage radiography, mammography enhancement by contrast media.
Geometric factors: magnification, distortion, positioning geometric and movement unsharpness, obliteration, micro- radiography, beam limitation, focal spot size.

THE RADIOLOGICAL IMAGING:

Image quality: description and meaning, resolution, noise, definition and contrast .

THE IMAGE RECEPTOR:

Intensifying screens: construction, physical principles and applications. X ray film: structure and operation, characteristic curve, density, speed, contrast, latitude, processing and the dark room, auto9matic x-ray film processor, function, principles, construction, advantages and disadvantages, handing and storage, labeling and identification . Design and care of cassettes. Display and perception of the radiographic image.
Image intensities construction, operation, brightness gain, optical couplings, TV systems.

Recording media: 35 mm cine film, 100mm or 60 mm spot film, video tape / disc.
Electrostatic processes: xeroradiography.

SCATTERED RADIATION:

Effect and control scatter: beam limitation, compression, grid construction and operation.
Radiographic subtraction technique. tomography (conventional): principles, layer thickness.
Digital fluoroscopic systems: data collection, storage and display including digital subtraction techniques, implication of digital storage media.

RADIATION PROTECTION:

Biological effects of radiation, risks of somatic and genetic effects. Objectives of radiation protection. Recommendations of I.C.R.P. concepts of dose equivalent quality factors, detriment, limitations annual limits of intake, radiological protection regulations. Relevant codes of practice. Dose control by design and by operation in diagnostic x-ray procedures and nuclear medicine for both staff and patients. Doses received in diagnostic procedures, population, somatic and genetic dose, risk estimates, benefits, personnel monitoring.

QUALITY ASSURANCE:

Methods of assessing image quality and their relationship to specifications of system performance. Methods of monitoring equipment performance.

B. **CLINICAL RADIOLOGY**:

BREAST:

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

CARDIAC:

- Knowledge of cardiac anatomy, and clinical practice relevant to clinical radiology
- Knowledge of the manifestations of cardiac disease demonstrated by conventional radiography
- Familiarity with the application of the following techniques:
- Radionuclide investigations
- Magnetic resonance imaging
- Angiography
- Reporting plain radiographs performed to show cardiac disease
- Supervising and reporting radionuclide investigations, computed tomography and / or magnetic resonance imaging performed to show cardiac disease
- Experience in echocardiography
- Performing / observing coronary angiography and other cardiac angiographic and interventional procedures.

CHEST:

- Knowledge of respiratory anatomy and clinical practice relevant to clinical radiology
- Knowledge of the manifestations of thoracic disease demonstrated by conventional radiography and C.T.
- Knowledge of the application of radionuclide investigations to chest pathology with particular reference to radionuclide lung scintigrams.
- Knowledge of the application, risks and contraindications of the technique of image – guided biopsy of chest lesions.
- Reporting of plain radiographs performed to show chest disease
- Supervising reporting radionuclide lung scintigrams
- Supervising and reporting computed tomography of the chest, including high – resolution examinations and C.T. pulmonary angiography
- Drainage of pleural space collections under image guidance
- Observation of image – guided biopsies of lesions within the thorax
- Familiarity with the applications of the following techniques :
- Magnetic resonance imaging
- Angiography
- Supervising and reporting magnetic resonance imaging
- Angiography

- Bronchography

GASTROINTESTINAL (Including Liver, Pancreas and Spleen):

- Knowledge of gastrointestinal anatomy and clinical relevant to clinical radiology.
- Knowledge of the radiological manifestations of disease within the abdomen on conventional radiography, contrast studies (including ERCP), Ultrasound, C.T. MRI, radionuclide investigations and angiography.
- Knowledge of the applications, contraindications and complications of relevant interventional procedures.
- Reporting plain radiographs performed to show gastrointestinal disease
- Performing and reporting the following contrast examinations:
- Swallow and meal examinations , - small bowel, studies – enema examinations
- Performing and reporting transabdominal ultrasound of the gastrointestinal system and abdominal viscera.
- Supervising and reporting computed tomography of the abdomen
- Performing:
- Ultrasound – guided biopsy and drainage, - computed tomography – guided biopsy and drainage.
- Performing and reporting the following contrast medium studies:
- Cholangiography (T.Tube) , - sonogram, - stomagram, GI video studies
- Experience of the manifestations of abdominal disease on MRI with particular reference to the solid viscera.
- Experience of the current application of radionuclide investigations to the gastrointestinal tract in the following areas:
- Live, - biliary system, - gastrointestinal bleeding (including Meckel's diverticulum) , - abscess localization, - assessment of inflammatory bowel disease
- Experience of the application of angiography and vascular interventional techniques to this subspecialty
- Experience of the relevant application of the following interventional procedures:
- Percutaneous biliary stenting , - balloon dilation of the oesophagus / stent insertion, - porto-systemic decompression procedures (TIPSS)
- Observation of ERCP and other diagnostic and therapeutic endoscopic techniques
- Endoluminal ultrasound
- Performing percutaneous cholangiography
- Observation of percutaneous gastrostomy
- Familiarity with performance and interpretation of the following contrast studies:
- Proctogram, - Pounchogram, -Herniogram

HEAD AND NECK IMAGING INCLUDING ENT / DENTAL:

- Knowledge of head and neck anatomy and clinical practice relevant to clinical radiology.
- Knowledge of the manifestations of ENT / dental disease as demonstrated by conventional radiography, relevant contrast examinations, ultrasound , C.T. and MRI
- Awareness of the application of ultrasound with particular reference to the thyroid and salivary glands and other neck structures
- Awareness of the application of radionuclide investigations with particular reference to the thyroid and parathyroids glands.
- Reporting plain radiographs performed to show ENT / dental disease
- Performing and reporting relevant contrast examination (e.g. barium studies including video swallows, sialography and dacrocystography)
- Performing and reporting ultrasound of the neck (including the thyroid , parathyroid and salivary glands)
- Supervising and reporting computed tomography of the head and neck for ENT problems
- Supervising reporting computed tomography for orbital problems
- Supervising and reporting magnetic resonance imaging in of the head and neck for ENT problems
- Reporting radionuclide thyroid investigations
- Performing biopsies of neck masses (thyroid, lymph nodes etc)
- Observation or experience in performing ultrasound of the eye
- Supervising and reporting computed tomography and magnetic resonance imaging of congenital anomalies of the ear
- Reporting radionuclide parathyroid investigations.

MUSCULOSKELETAL INCLUDING TRAUMA:

- Knowledge of musculoskeletal anatomy and clinical practice relevant to clinical radiology
- Knowledge of normal variants of normal anatomy, which may mimic trauma
- Knowledge of the manifestations of musculoskeletal disease and trauma as demonstrated by conventional radiography, C.T., MRI , contrast examinations, radionuclide investigations and ultrasound.
- Reporting plain radiographs relevant to the diagnosis of disorders of the musculoskeletal system including trauma.
- Reporting radionuclide investigations of the musculoskeletal system, particularly skeletal scintigrams .
- Supervising and reporting computed tomography of the musculoskeletal system

- Supervising and reporting magnetic resonance imaging of the musculoskeletal system
- Performing and reporting ultrasound of the musculoskeletal system.
- Supervising C.T. and MRI of trauma patients
- Experience of the relevant contrast examinations (e.g. arthrography)
- Familiarity with the application of angiography
- Awareness of the role and, where practicable, the observation of discography and facet injections.
- Observation of image – guided bone biopsy

NEURORADIOLOGY:

- Knowledge of neuroanatomy and clinical practice relevant to neuroradiology
- Knowledge of the manifestations of CNS disease as demonstrated on conventional radiography, C.T. MRI myelogrpahy and angiography
- Awareness of the applications, contraindications and complications of invasive neuroradiological procedures.
- Familiarity with the application of radionuclide investigations in neuroradiology.
- Familiarity with the application of C.T. and MR angiography in neuroradiology
- Reporting plain radiographs in the investigation of neurological disorders
- Supervising and reporting cranial and spinal computed tomography
- Supervising and reporting cranial and spinal magnetic resonance imaging
- Observation and reporting of cerebral angiograms
- Observation of carotid ultrasound including Doppler.
- Experience in MR angiography and CT angiography to image the cerebral vascular system.
- Performing and reporting cerebral angiography
- Performing and reporting myelograms
- Performing and reporting transcranial ultrasound
- Observation of interventional neuroradiological procedures
- Observation of magnetic resonance spectroscopy
- Experience of functional brain imaging techniques (radionuclide and MRI)

OBSTETRICS AND GYNAECOLOGY:

- Knowledge of obstetric and gynecological anatomy and clinical practice relevant to clinical radiology

- Knowledge of the physiological changes affecting imaging of the female reproductive organs
- Knowledge of the changes in fetal anatomy during gestation and the imaging appearances of fetal abnormality
- Awareness of the applications of angiography and vascular interventional techniques
- Awareness of the applications of magnetic resonance imaging in gynecological disorders and obstetrics
- Reporting plain radiographs performed to show obstetric and gynecological disorders.
- Performing and reporting transabdominal and endovaginal ultrasound in gynecological disorder.
- Supervising and reporting computed tomography in gynecological disorders.
- Supervising and reporting magnetic resonance imaging in gynecological disorders
- Performing and reporting hysterosalpingography
- Performing and reporting transabdominal and endovaginal ultrasound in obstetrics
- Supervising and reporting magnetic resonance imaging in obstetric applications (eg assessing pelvic dimensions)
- Observation of fetal MRI
- Observation of angiography and vascular interventional techniques in gynecological disease.

ONCOLOGY:

- Knowledge of clinical practice relevant to clinical radiology
- Familiarity with tumor staging nomenclature
- Familiarity with the application of ultrasound, radionuclide investigations, computed tomography , and magnetic resonance imaging , angiography and interventional techniques in oncological staging, and monitoring the response of tumors to therapy.
- Familiarity with the radiological manifestations of complications which may occur in tumor management.
- Reporting plain radiographs performed to assess tumor
- Performing and reporting ultrasound, C.T. MRI and radionuclide investigations in oncological staging and monitoring the response of tumours therapy.
- Performing image – guided biopsy of masses under US and CT guidance.
- Familiarity with the practical application of PET imaging in tumor staging and management

PAEDIATRIC:

- Knowledge of pediatric anatomy and clinical practice relevant to clinical radiology
- Knowledge of disease entities specific to the pediatric age group and their clinical manifestations relevant to clinical radiology.

- Knowledge of disease entities specific to the pediatric age group and their manifestations as demonstrated on conventional radiography, ultrasound, contrast studies, CT, MRI and radionuclide investigations
- Reporting plain radiographs performed in the investigation of pediatric disorders including trauma.
- Performing and reporting ultrasound in the pediatric age group in the following areas:
- Transabdominal , - transcranial
- Performing and reporting routine fluoroscopic procedures in the pediatric age group particularly:
- Contrast studies of the urinary tract
- Contrast studies of the gastrointestinal system
- Supervising and reporting computed tomography and magnetic resonance imaging
- Supervising and reporting radionuclide investigations in the pediatric age group
- The management of suspected non – accidental injury (NAI)
- The practical management of the following pediatric emergencies:
- Neonatal gastrointestinal obstruction, - intussusceptions
- Performing and reporting ultrasound in the pediatric age group in the following areas:
- Musculoskeletal, - chest

UROradiology:

- Knowledge of urinary tract anatomy and clinical practice relevant clinical radiology
- Knowledge of the manifestations of urological disease as demonstrated on conventional radiography, ultrasound , C.T. and MRI
- Familiarity with the current application of radionuclide investigations for imaging the following:
- Kidney, - renal function, - vescio-ureteric reflux
- Awareness of the application of angiography and vascular interventional techniques
- Reporting plain radiographs performed to show urinary disease.
- Performing and reporting the following contrast studies :
- Intravenous urogram, - retrograde pyelo-ureterography , - loopogram, - nephrostogram, - ascending urethrogram, - micturating cysto-urethrogram
- Performing and reporting transabdominal ultrasound to image the urinary tract
- Supervising and reporting computed tomography of the urinary tract
- Reporting radionuclide investigations of the urinary tract in the following areas;
- Kidney, - renal function,-vesico-reteric reflux

- Performing nephrostomies
- Observation of percutaneous ureteric stent placement
- Endorectal ultrasound
- Performing image- guided renal biopsy under US and C.T. guidance.
- Magnetic resonance imaging applied to the urinary tract
- Experience of angiography and vascular interventional techniques
- Experience of antegrade –uretherography
- Urodynamics

VASCULAR AND VASCULAR INTERVENTION:

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

- Ultrasound (including Doppler)
- Intravenous digital subtraction angiography
- Intra-arterial angiography
- Computed tomography and C.T. angiography
- Magnetic resonance imaging and MR angiography

- Reporting plain radiographs relevant to cardiovascular disease
- Femoral artery puncture techniques, and the introduction of guide wires and catheters into the arterial system.
- Venous puncture techniques both central and peripheral and the introduction of guide wires and catheters into the venous system.
- Performing and reporting the following procedures:

-lower limb angiography
- arch aortography
- abdominal aortography
- lower limb venography (contrast or ultrasound)

- Performing the following techniques:

- Ultrasound (including Doppler),- venous and arterial

- Intravenous digital subtraction angiography
- Supervising and reporting CT examination of the vascular system (CTA) including image manipulation
- Supervising and reporting MRI examinations of the vascular system (MRA) including image manipulation.
- Selective angiography (e.g. hepatic, renal, visceral)
- Pulmonary angiography
- Alternative arterial access (eg brachial , axillary puncture)
- Upper limb venography
- Portal venography
- Pelvic venography via femoral approach
- Superior vena cavography
- Inferior vena cavography
- femoral angiography , iliac angiography, renal angiography , embolisation , thrombolysis, stenting, caval filter insertion.

C: MODALITIES IN RADIOLOGY:

COMPUTED TOMOGRAPHY:

- knowledge of the technical aspects of performing computed tomography (CT, including the use of contrast media
- knowledge of the cross – sectional anatomy as visualized on computed tomography
- Practical experience in supervision including vetting requests, determining protocols, the examination and post processing and reporting of the examination in the following anatomical sites:

- brain, - head and neck, - chest , - abdomen and pelvis, - musculoskeletal vascular.

- Experience in performing computed tomography – guide procedures, e.g. biopsy and drainage.
- Familiarity with the application of CT angiography
- Familiarity with post image acquisition processing

These examination may be performed during a system – based attachment, e.g. neuroradiology, or during a computed tomography attachment.

MAGNETIC RESONANCE:

- Understanding of current advice regarding the safety aspects of magnetic resonance imaging (MRI)

- Knowledge of the basic physical principles of magnetic resonance imaging including the use of contrast media
- Knowledge of the cross- sectional anatomy in orthogonal planes, and the appearance of normal structures on different pulse sequences.
- Experience in supervision including vetting requests, determining protocols, the examination, and post processing and reporting of the examinations in the following anatomical sites:

- Brain, - head and neck, - chest – abdomen and pelvis, musculoskeletal (e.g. hips, knees, shoulders and extremities)

- Experience of the application of MR angiography and venography
- Familiarity with post image acquisition processing

NB: this experience may have been gained during a system – based attachment, or during a magnetic resonance attachment.

ULTRASOUND:

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

- Performing ultrasound – guided interventional procedures (e.g. biopsy and drainage)
- Interventional
- Familiarity with the equipment and techniques used in vascular, biliary, and renal interventional techniques.
- Familiarity with the indications, contraindications, pre-procedure preparation including informed consent, patient monitoring during the procedure and post procedure patient care
- Familiarity with procedure and post procedure complications and their management
- Performing nephrostomies
- Ultrasound –guided interventional procedures (e.g. biopsy and drainage)

FLOUROSCOPY:

Plain film

- Barium Enema
- Barium Meal
- Small Bowel Barium Enema
- Sialogram
- T-Tube cholangiogram
- Knee Arthrogram
- Sinogram/Fistulogram
- Leg Venogram
- Angiographic Examination
- Hysterosalpingogram
- Lymphangiogram

D: NON CLINICAL ELECTIVES

RESEARCH

Residents are encouraged to engage in clinical or basic science research during their training through our Comprehensive**mentoring program**.At the beginning of this rotation, resident will be asked to identify a research topic or project and be linked with a research mentor. Resident will gain broad understanding of the fundamental principles and methods of research: developing research questions, analyzing current literature, designing studies (including statistical analysis), presenting research projects and writing them up.Residents receive close supervision by their preceptor throughout all phases of the research project, learning the process from hypothesis development to IRB

(Institutional Review Board) submission through experimentation, data collection and analysis, and formal writing for presentation and publication. At the **Resident Research Forum,** residents present their work-in-progress to peers and faculty.

MANDATORY WORKSHOPS:

1. Each candidate of MD/MS/MDS program would attend the 04 mandatory workshops in first and second year of training as required by the University.
2. The four mandatory workshops will include the following:
   a) Research methodology and biostatics
   b) Basic life support
   c) Communication skills
   d) Introduction to computer / information Technology and Software programs
3. The workshops will be held on 03 monthly basis.
4. Certificates of attendance will be issued upon satisfactory completion.

COMPULSORY ROTATIONS

The frame work for core training will consist of the rotations in

- Nuclear medicine - for 6 weeks
- MRI I and II - for 16 weeks
- Interventional Radiology I and II – for 8 weeks
- Echocardiography- 2 weeks
- Research

The educational objective of rotations is to give appropriate experience in relevant fields

ROTATION LOG OF NUCLEAR MEDICINE:

- Secure knowledge of the relevant aspects of current legislation regarding the administration of radiopharmaceuticals.
- Knowledge of the technical aspects of radionuclide radiology relevant to optimizing image quality.
- Knowledge of the radiopharmaceuticals currently available for the purposes of imaging organs and locating inflammatory collections, tumours and sites of hemorrhage.
- Knowledge of the relevant patient preparation, precautions (including drug effects), and complications of the more commonly performed radionuclide investigations.
- Knowledge and understanding of the principles and indications of the more commonly performed radionuclide investigations and how these relate to other imaging modalities, in particular knowledge of the radionuclide investigations in the following topic areas:

- Cardiology, - endocrinology, - gastroenterology and hepato- biliary disease, - haematology, - infections , - lung disease, - Nephro-urology, - nervous system, - oncology, - pediatrics, - skeletal disorders , understating the significance of significance of normal and abnormal results.

- Knowledge of the strengths and weaknesses of radionuclide investigations compared to other imaging modalities.
- Experience in supervision and reporting of radionuclide investigations
- Familiarity with the practical application of PET imaging

NB: ideally the training in radionuclide radiology should take place during a radionuclide imaging attachment, but it may occur in part or wholly during a system – based attachment.

ROTATION LOG OF INTERVENTIONAL RADIOLOGY:

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

- Intravenous digital subtraction angiography
- Intra-arterial angiography

- Computed tomography and C.T. angiography
- Magnetic resonance imaging and MR angiography
- Femoral artery puncture techniques, and the introduction of guide wires and catheters into the arterial system.
- Venous puncture techniques both central and peripheral and the introduction of guide wires and catheters into the venous system.
- Performing and reporting the following procedures:

-lower limb angiography
- arch aortography
- abdominal aortography
- lower limb venography (contrast or ultrasound)

- Performing the following techniques:
- Intravenous digital subtraction angiography
- Selective angiography (e.g. hepatic, renal, visceral)
- Pulmonary angiography
- Alternative arterial access (eg brachial , axillary puncture)
- Upper limb venography
- Portal venography
- Pelvic venography via femoral approach
- Superior vena cavography
- Inferior vena cavography
- femoral angiography , iliac angiography, renal angiography , embolisation , thrombolysis, stenting, caval filter insertion.

ROTATION LOG OF ECHOCARDIOGRAPHY:

Transthoracic echocardiography

1. Understand the physics involved in image acquisition and blood velocity measurement.
2. Understand and be able to properly use echocardiographic equipment.
3. Acquire a working knowledge of cardiac anatomy, physiology, hemodynamics, and pathology relevant to echocardiography.
4. Understand fluid dynamics and cardiovascular blood flow.
5. Understand the role of these procedures in clinical practice, including: diagnostic and prognostic utility, cost, and limitations.

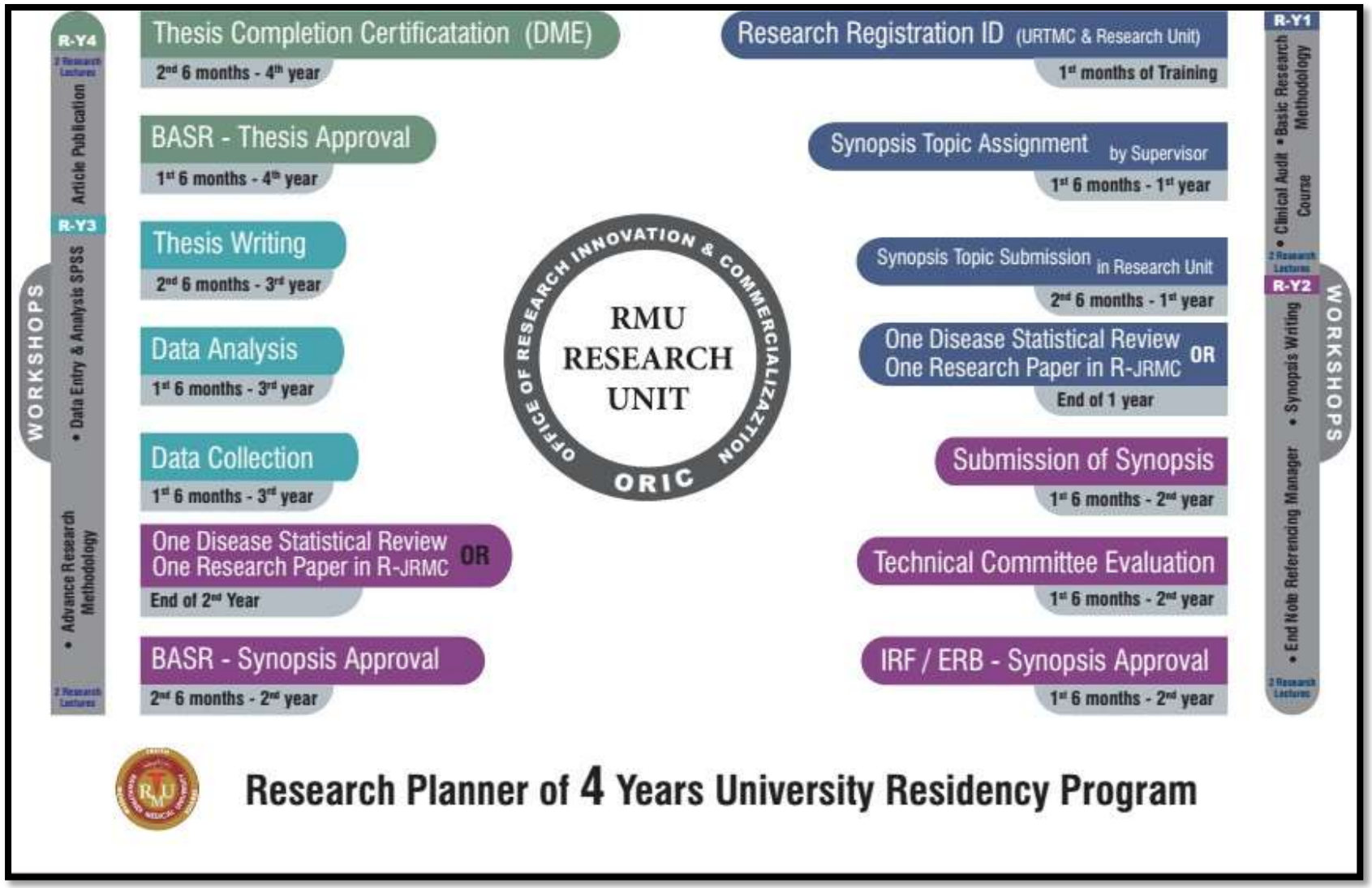
Transesophageal echocardiograpy and stress echocardiography

1. Understand the indications, contraindications, and risks of transesophageal echocardiography.
2. Gain experience in esophageal intubation, probe passage, acquisition, and interpretation of transesophageal echocardiography.
3. Understand the indications, contraindications, and risks of stress echocardiography.
4. Gain experience in the analysis of images and interpretation of stress echocardiography.

ROTATION LOG OF MRI:

These have been described above

APPENDIX 3: RESEARCH PLANNER



APPENDIX 4: TABLE OF SPECIFICATION (TOS)

First In-Training Assessment (MCQ=100)		Mid-term Assessment			Third In-training Assessment (MCQ=100)	Final Assessment				
		Paper 1 (physics, radiological anatomy) (75)	Paper 2 (basic radiology) (75)	OSCE (150)		Paper 1 (MCQ=100)	Paper 2 (SEQ=10 each of 10 marks)	OSCE (300)	VIVA VOCE (200)	Thesis (100)
Radiological physics	30	25	--	15 slides of 10 marks each=150 (50% static stations 50% interactive stations)	--	--	--	30 slides of 10 marks each	3 stations(2 units each)=200	-----
Radiological anatomy	30	25	--		-	--	--			--------
Nuclear medicine	10	10	--		--	--	--			
Radiological procedures& positioning	15	15	--		--	--	--			
Emergency radiology	15		10							
chest & CVS	--	--	10		20	15	01			
GIT & hepatobiliary	--	--	15		20	20	02			
genitourinary	--	--	15		20	20	02			
musculoskeletal	--	--	10		15	20	02			
breast	--	--	05		10	05	01			
CNS and spine	--	--	10		15	20	02			

SECTION 8

RECOMMENDED BOOKS

1. Ryan S. ***Anatomy for Diagnostic Imaging.*** 2nd ed. Saunders;2004 .
2. Bushong S. C. ***Radiological Science for Technologists Physics, Biology and Protection.*** 8th ed.Mosby;2004.
3. Chapman S. and Nakienly R. ***A Guide to Radiological Procedures***. 4th ed. Baillier Tindall, Jaypee Brothers; 2001.
4. Chapman S. and Nakielny R. ***Aids to Radiological Differential Diagnosis.*** 4th ed. Elsevier Science Limited; 2003.
5. Sutton D. ***Textbook of Radiology and imaging (Vol. l and ll).***7th ed. UK: Churchill Livingstone; 2003.
6. Clark. ***Clark's Textbook of Positioning in Radiology***. 12th ed. Hoddler Arnold Publications; 2005.
7. Farr.***Physics for medical imaging.*** 2nd ed.Saunders;2007
8. Dahnert W. ***Radiology review manual.***7th ed. 2011
9. Diagnostic Radiology – Graninger& Allison
10. Christensen's Physics of Diagnostic Radiology – Thomas S. Curry et al.
11. Clinical Doppler Ultrasonography – Paul L. Allen

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2. https://www.academicradiology.org/article/S1076-6332(11)00064-X/fulltext
3. http://www.brownmedicine.org/2/cardiology/echo.pdf
4. https://www.acgme.org/Portals/0/PDFs/Milestones/DiagnosticRadiologyMilestones.pdf
5. https://www.apdr.org/-/media/Files/APDR/Program-Directors/Resources/general_competencies