SAUDI **NEURORADIOLOGY** FELLOWSHIP CURRICULUM

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بسم الله الرحمن الرحيم

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Saudi Commission for Health Specialties

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Many of the descriptions and radiology competencies were acquired from the CanMEDS framework of the Royal College of Physicians and Surgeons of Canada.

FOREWORD

In this curriculum, we are adopting the CanMEDS framework, as it is an innovative, competency-based framework that describes the core knowledge, skills, and attitude of physicians. This curriculum is intended to provide a broad framework for fellows, faculty (by focusing on teaching, learning, and clinical experience), and professional development during the training program. This does not intend to be the sole source of information regarding the definition of what is to be taught and learned during the residency training. Fellows are expected to acquire knowledge and skills as well as develop an appropriate attitude and behavior throughout their training program, while taking personal responsibility in learning. They must learn from each patient encountered, whether or not that particular condition or disease is mentioned in this curriculum.

This curriculum is part of the strategic planning of SCFHS and is aimed at reviewing and updating the curricula of the training programs. It was developed and reviewed by The Scientific Council of the Saudi Neuroradiology Fellowship Program Board and local Advisors.

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INTRODUCTION

1. Context of Practice (Neuroradiology)

Neuroradiology is the subspecialty of radiology concerned with the diagnosis and management of patients with neurological, head and neck, spinal, maxillofacial, and ophthalmological disorders. It plays a major role in the management of those patients.

Recent years witnessed a great development and advancement in medical disciplines, including neurosciences, otolaryngology, oncology, and medical imaging, which were accompanied by an increase in the utility of various neuroimaging studies in both clinical and research settings.

Neuroimaging has matched the developments in these areas and has become one of the broadest subspecialties and the most demanded service in secondary and tertiary healthcare settings. Furthermore, qualified neuroradiologists are an essential requirement for the safe and efficient practice of neuroimaging. In these settings, the complexity of clinical cases requires an experience that goes beyond that of general radiology.

2. Goal and Responsibility of Curriculum Implementation

To meet the demand of the growing healthcare services in the Kingdom of Saudi Arabia, and to overcome the increasing competition and difficulty of admission to neuroradiology fellowship programs internationally, a national neuroradiology Fellowship Program that meets the international standards and bridges the gap in the demand for this subspecialty was started in 2013. The goal of training quality neuroradiologists in the local setting is feasible given the presence of an adequate number of national neuroradiologists who were trained in elite centers and are currently practicing in well-equipped hospitals in the Kingdom.

The Neuroradiology Fellowship is a two-year appointment in a joint fellowship program at the centers accredited by the Saudi Commission for Health Specialties. The overall intent of the program is to provide the fellows with specific knowledge on clinical utility, radiation and patient safety, indications/contraindications, technical evaluation, image interpretation, and the standards of performance of neuroradiological studies.

The Neuroradiology Fellowship program provides fellows with instruction and experience in the anatomy, normal variants, pathophysiology, and imaging features of diseases of the brain, ENT, orbits, spine, and related structures. The major neuroimaging modalities include computed tomography (CT), magnetic resonance imaging (MRI), and neurointerventional procedures (including catheter angiography and myelography), as well as the clinical applications of advanced MR techniques such as Dynamic Susceptibility Contrast (DSC) MR perfusion, Dynamic Contrast Enhanced (DCE) MR perfusion, Arterial Spin (ASL) MR perfusion, diffusion tensor imaging (DTI) and tractography, functional MRI, MR spectroscopy, and CT perfusion.

Neuroradiology is best learned as an integrated aspect of the clinical care of patients. A more in-depth neuroradiology training through formal preceptorships and rotations at neuroradiology centers is mandatory. Upon completion of the training program, fellows will be competent in the clinical practice of neuroradiology and will be prepared to conduct clinical and/or clinical-based research.

The fellows will also have the ability to teach at both the undergraduate and postgraduate levels.

The purpose of this curriculum is to define the process of training and the competencies required for the award of the Saudi Board Certification in Neuroradiology.

After training completion, the neuroradiologist will have the competencies required to be able to work as a consultant and will be in a position to develop further a subspecialist-level interest within neuroradiology.

This curriculum will be reviewed every four years or at any time that is deemed necessary. All trainees who satisfactorily complete the program are eligible candidates for the SCFHS Neuroradiology Fellowship Examination.

3. What is new in this edition?

This curriculum replaces the previous version of the Saudi Neuroradiology Fellowship Training Program SNFTP curriculum, dated 2013. The revisions ensure conformance with the updated SCFHS regulations and the framework laid out by the Canadian Medical Education Directions for Specialists (CanMEDS). The present version of the SNFTP curriculum follows the competency-based framework adopted by the SCHS. In addition, the following changes have been included in this version:

All rotations of the fellowship program, as well as educational activities, are now described in a competency-based format with clear objectives according to the roles defined in the CanMEDS framework for the subspecialty of Neuroradiology: Medical Expert, Communicator, Collaborator, Leader, Health Advocate, Scholar, and Professional.

Major changes were made regarding the duration of rotations (from a monthly to a weekly timing) and related definitions. The list of the most important clinical topics and procedures in neuroradiology, and the list of universal topics have been expanded. The methods of assessment for every rotation have been revised. New assessment tools for evaluation and promotion to the next level in training have been approved. Such tools include structured oral examination (SOE), objective structured clinical examination (OSCE), and assessment of academic activities.

New sections pertaining to mentoring, rules and regulations, and logbook (including the minimum cases needed per rotation) have been added.

4. Policies and Procedures

This curriculum represents the means and materials outlining the learning objectives with which trainees and trainers will interact for the purpose of achieving the identified educational outcomes. The Saudi Commission for Health Specialties (SCFHS) has a full set of “General Bylaws” and “Executive Policies” (published on the official SCFHS website) that regulate all processes related to training. General bylaws of training, assessment, and accreditation, as well as executive policies on admission, registration, continuous assessment and promotion, examination, trainees’ representation and support, duty hours, and leaves, are examples of regulations that need to be applied. Trainees, trainers, and supervisors need to apply this

curriculum in compliance with the most updated bylaws and policies, which can be accessed online (via the official SCFHS website).

The Saudi Neuroradiology Fellowship Training Program adheres to the rules and regulations of the SCFHS with respect to the rights and duties of trainees. These rules are freely distributed to all trainees to make them aware of their duties and rights regarding clinical and nonclinical issues, as well as to ensure that the SCFHS goals for the training programs are fulfilled. A complete copy of the relevant SCFHS rules and regulations are available on the SCFHS website.

Examples of training polices

On-call duties:

Fellows will be assigned to appropriate on-call duties according to a prearranged department schedule. On-call duties must follow SCFHS rules and regulations.

General training methods for on-call duties:

- Consultation with the consultant-on-call and residents regarding difficult cases.
- Reporting the findings of on-call radiology examinations under senior staff supervision, as per hospital policy.
- Adherence to hospital policies and procedures pertinent to on-call radiology services.
- Feedback from seniors regarding performance during on-call duties and opportunities for improvement.
- Presentation of educational cases managed during on-call duties at department meetings, under supervision.
- Supervision of on-call radiology examination reporting by the residents, or reporting these examination findings, as per hospital policy.
- Supervision of residents during their presentation of educational cases managed during on-call duties at department meetings.

Vacation leave:

Fellows are granted vacation leaves as per SCFHS rules and regulations. Requests for vacation time must be approved by the Program Director. Requests for vacation time must be submitted at least four weeks in advance. In addition, Fellows are granted conference leave for a period not exceeding seven working days per academic year, as per SCFHS rules and regulations. The conference must be approved by the Program Director.

Radiation and safety:

The fellow will acquaint him/herself with all aspects related to radiation and magnetic field safety and protection, according to accepted guidelines of practice, to ensure the safety of patients and staff alike.

5. Abbreviations Used in This Document

Abbreviation	Description
SCFHS	Saudi Commission for Health Specialties
F(1)	(First) year of Fellowship
F(2)	(Second) year of Fellowship
SNFTP	Saudi Neuroradiology Fellowship Training Program
OSE	Oral Structural Examination
OSCE	Objective Structured Clinical Examination
OSPE	Objective Structured Practical Examination
Mini-CEX	Mini-Clinical Experience report
CBD	Case-Based Discussion Report
CBE	Competency-Based Education
ITER	In-Training Evaluation Report
Blueprint	A tool that identifies the content areas covered on the examination. For each content area, the blueprint outlines the weighting of the area, the domains, and sections examined. The blueprint also provides details of the assessment tools used in the examination.
Competence	Possession of a satisfactory level of relevant knowledge and acquisition of a range of relevant skills that include interpersonal and technical components at a certain point in the educational process.
Portfolio	A systematic and organized collection of a candidate's work that showcases to others the direct evidence of a candidate's efforts, achievements, and progress over a period.
Universal topics	A knowledge, skills, or professional behavior that is not specific to the given specialty but universal for the general practice of a given healthcare profession.
Summative assessment	An assessment that describes the composite performance of the development of a learner at a particular point in time and is used to inform judgment and make decisions about the level of learning and certification.

PROGRAM STRUCTURE

1. Program Entry Requirements

To be accepted into the training program, the candidate must fulfil the following requirements (we advise the trainees to visit the SCFHS website (scfhs.org.sa) for additional details or updates on the executive policy of SCFHS regarding admission and registration):

1) A medical degree (e.g., M.B.B.S) or equivalent from a recognized university.
2) Saudi Board of Radiology certificate or equivalent from a recognized institute (which is approved by the Saudi Commission) or at least the successful completion of the written component to the Saudi Specialty Certificate in Radiology.
3) License to practice medicine in Saudi Arabia.
4) The provision of a letter from a sponsoring organization giving approval for the candidate to undertake full-time training for the entire duration of the program (two years).
5) Successful passing of the interview stage.
6) Three letters of recommendation from consultants with whom the candidate has recently worked.

2. Requirements during the program

2.1. General requirements:

1) The trainee shall abide by the training regulations and obligations as set by the Saudi Commission for Health Specialties.
2) Training is a full-time commitment. The trainee shall be enrolled in full-time, continuous training for the entire duration of the program.
3) The training is to be conducted in institutions accredited by SCFHS for Saudi Board of Radiology and Neuroradiology fellowship training programs.
4) The training will be comprehensive and include all aspects designated in the structure and content of the Neuroradiology fellowship program.
5) Trainees shall be actively involved in patient care with gradual progression of responsibility.

2.2. Mentorship

Each new Fellow entering the Program will be asked to select a faculty mentor who will be available to them while they are enrolled in the Fellowship Program. Fellows who do not have a mentor six months after starting the program will be assigned a mentor by the program director.

Fellows have the opportunity to choose their own mentor. It is recognized that many fellows entering the fellowship training program will have little knowledge of faculty members initially. However, after a period of six months, fellows should be in a position to choose a mentor and it is expected that, half way through the first academic year, each new fellow will approach a potential mentor. Fellows will be reminded of this aspect at six months into the program. If they have not selected a mentor by this time, a mentor will be selected for them by the program director. Fellows who require help approaching a mentor or feel like they need to change mentors need to contact the Director of the Training Program.

The following is a summary of the role of the mentor, as well as the principles outlining the way in which the mentorship system should operate.

1) The mentor's main responsibility will be to assist the fellow in making decisions regarding training issues and career choices. The mentor should be supportive to the fellow and take on a role as the fellow's advocate.
2) While the frequency of meetings between the fellow and the mentor may vary, the mentor should meet with each mentee a minimum of four times per academic year (30–60 minutes).
3) The mentor should review the rotation evaluations on a regular basis and discuss pertinent weaknesses/strengths with the mentee, to improve his/her academic standing. The same applies to performance on in-training exams.
4) The mentor is encouraged to review each mentee's rotations annually, such that they meet educational/research objectives and to ensure that exposure to a broad range of Neuroradiology topics has been achieved at the completion of the program.

3. Program Duration:

This is a two-year (104-week) fellowship program that consists of two parts: the clinical training and the research training.

4. Program Rotations:

To complete the training successfully, a fellow must be active for a minimum of 22 months (96 weeks) in the fellowship.

The sequence of the clinical rotations will be determined by the local supervisory training committee.

Rotations roadmap

The number of weeks allotted to training in each area is summarized below:

Rotation	First year	Second year	Total
Head & neck imaging	12	12	24
Neurointervention	8	-	8
CT brain & spine	12	12	24
Pediatric neuroradiology	-	8	8
MRI brain & spine	12	12	24
Elective	4	-	4
Research	-	4	4
Vacation	4	4	8
Total	52	52	104

Clinical rotations

- **CT Brain and Spine:**
  All brain and spine CT examinations, including trauma, and the use of intravenous injection of contrast agents as well as advanced imaging (such as CT perfusion) should be prescribed, supervised, interpreted, and reported by the fellow. Radiation safety, contrasts, and related artifacts must be learned. Emphasis will be placed on learning multidetector CT techniques for a wide variety of applications. Specialized examinations, such as CT angiography and CT venography, should all be learned. As some examinations also include imaging of the orbits, paranasal sinuses, neck, and spine, there will be significant exposure to diseases of these areas, which will serve as an introduction to the dedicated rotations in the program. The fellow should become comfortable after this period regarding the manipulation of the imaging data at dedicated 3D workstations, for both interpretation and illustration.

- **MRI Brain and Spine:**
  Emphasis must be placed on learning the practical physical principles related to neuroradiology, including MR angiography, MR spectroscopy, MR perfusion, functional MRI, diffusion tensor imaging, and tractography. Fellows should be heavily involved in the direct supervision of examinations and in working with technologists to make the necessary adjustments to parameters and protocols as the studies are being performed. MR safety, indications, and precautions for the use of a variety of MR contrast agents should also be learned. Detailed knowledge of MR artifacts should be acquired and mastered. Proper post-processing of imaging data is a central part of this rotation.

- **Head & Neck imaging:**
  Emphasis must be placed on detailed knowledge of imaging of the anatomy of the head & neck region, including the paranasal sinuses, neck, orbits, skull base, and temporal bone. The fellow must also be familiar with the different pathologies in these areas and with the best radiological management of such conditions.

- **Pediatric Neuroradiology:**
  Emphasis must be placed on the particular issues of neuroradiology that are different between children and adults, particularly the issues related to radiation protection, sedation, and MR safety. The fellow must become familiar with the imaging of the congenital and acquired conditions that are encountered in the pediatric population. During this rotation, the fellow shall be responsible for all CT & MR neuroradiology interventions in children.

- **Neurointervention Rotation:**
  This rotation is dedicated to diagnostic and interventional radiology of the neurovascular system. This will include CT and MR vascular imaging, as well as neurointerventional procedures. The fellow shall master the post-processing of CT and MR angiography studies on dedicated workstations and shall be aware of, and familiar with, the current neurointerventional procedures.

- **Elective Rotation:**
  The fellow can arrange his/her own one-month elective rotation during the first year in any area of interest. The elective rotation will provide the fellow with the opportunity to gain additional training in a specialized area of interest. This period allows flexibility to enhance exposure to certain areas in the field of neuroradiology, or to work in areas of particular

interest to the fellow. Examples of elective rotations are: adult neurology, pediatric neurology, neurosurgery, neurophysiology, and neuropathology.

- **Research Activity**
  One month of dedicated research rotation during the second year is granted to the fellow for the completion of one peer-reviewed journal publication in which the fellow is the primary author, supervised by a staff member(s). Fellows will be trained in basic clinical research in neuroscience. The guiding principle of the clinical research education is to have fellows of the Neuroradiology Fellowship Program perform a clinical research project under the mentorship program.

  Each fellow will have a research mentor. The selection of the research mentor will be carried out by the fellow, but must be approved by the local training committee. Fellows must submit a written research proposal, which will be reviewed by the local training committee.

  The fellow shall cover most of the knowledge-based objectives by the end of the second year.

LEARNING AND COMPETENCIES

1. Introduction to Learning Outcomes and Competency-Based Education

Goal

On completion of the SNFTP, trainees will be able to function as consultants with core competencies in Neuroradiology, as per the SCFHS regulations.

Mapping of Milestones

This curriculum applies the principles of competency-based medical education. CanMeds represents a globally accepted framework that outlines competency roles. The "CanMeds 2015 framework" has been adopted in this section.

Trainees are expected to progress from the novice to the mastery level regarding a certain set of professional competencies. SCFHS has endorsed the CanMEDs framework to articulate professional competencies. The following is a general outline of each competency (adopted from Frank JR, Snell L, Sherbino J, Editors. CanMEDS 2015 Physician Competency Framework. Ottawa: Royal College of Physicians and Surgeons of Canada; 2015 and *The Royal College of Physicians and Surgeons of Canada*. *Objectives of Training in the Subspecialty* of *Neuroradiology*. EDITORIAL REVISION JUNE 2018, VERSION 2.1). For additional details please refer to the reference below.

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2. Specific rotation-based competencies

Throughout the training, the trainee is expected to assume responsibility for self- assessment and reflection, to pursue self-directed learning and the maintenance of competence, and to utilize all reasonable opportunities for gaining competencies.

This section identifies the types of situations in which a trainee will learn.

2.1 NEURO CT ROTATION

Number of rotation weeks	First year	Second year	Total
	12	12	24

In addition to the general competencies addressed under General Radiological Objectives (Competencies), the following competencies are also required for this rotation.

MEDICAL EXPERT

- To recognize the detailed and complex CT radiological anatomy of the brain, skull, and spine.
- To understand specialized examinations, such as CT angiography and CT myelography. As some examinations also include imaging of the orbits, paranasal sinuses, neck, and spine, there will be significant exposure to diseases involving these areas, which will serve as introduction to the dedicated rotations in the program.
- To learn advanced imaging techniques, such as multidetector CT techniques, for a wide variety of applications (CT perfusion imaging techniques/dual energy CT application in neuroradiology).
- To recognize unusual imaging presentations of common pathologies.
- To develop a strong fund of differential diagnostic possibilities for brain CT imaging findings.
- To recognize & recommend the most appropriate next step in patient management.
- To exhibit competency in the understanding and interpretation of the imaging findings and management of the following brain and spine emergency presentations:
  - Intracranial and spinal bleeding
  - Stroke
  - Cerebral edema
  - Cerebral venous thrombosis
  - Acute white matter diseases
  - Brain herniation
  - Hydrocephalus
  - Cerebral and meningeal infections
  - Traumatic injury of the brain, skull, face, and neck
  - Traumatic spine injuries
- To understand the imaging findings of the following common neurological conditions:
  - Common congenital malformations
  - Common inflammatory diseases
  - Common neoplasms
  - Common infection
  - Degenerative spine diseases
  - Scoliosis
- To learn interpretation and reporting of CT angiography and master the normal variation of the arteries and the following common diseases:
  - Aneurysm
  - Dissection
  - Atherosclerotic diseases
  - Occlusion
  - Moyamoya disease
  - Fibromuscular dysplasia (FMD)
  - Traumatic injuries

- To learn interpretation and reporting of CT myelography.
- To exhibit competency in prioritization, protocol development, and interpretation of normal and abnormal neuro-CT.
- To identify and appropriately manage contrast media complications.
- To perform basic post-processing of vascular and volumetric neuro-CT.
- To demonstrate an understanding of the advanced CT physics and techniques related to neuroradiology, e.g., perfusion, etc.

Fellows skills:

- To be able to correlate imaging findings with clinical data and other imaging data and generate appropriate lists of differential diagnoses.
- To generate an appropriate opinion about complex imaging findings.
- To perform common post-processing tasks for neuroradiology studies, including multi-planar reformations (MPR), maximum intensity projections (MIP), minimum intensity projections (MiniIP), and vessel analysis.
- To be able to prescribe, supervise, interpret, and report CT scans.
- To acquire and practice manipulating the imaging data at dedicated 3D workstations, for both interpretation and illustration.

COMMUNICATOR

- To obtain the appropriate information during consultation with referring physicians, to be able to make recommendations regarding the most appropriate testing and/or management of patients.
- To discuss appropriate information with patients/families and the healthcare team when needed.
- To understand the importance of communication with referring physicians, including an understanding of when the results of an investigation or procedure should be urgently communicated in situations of emergency.

COLLABORATOR

- To consult effectively with other colleagues and healthcare professionals.
- To contribute effectively to other interdisciplinary team activities.

MANAGER

- To work efficiently in a healthcare organization.
- To help in assigning cases to various modalities effectively and proficiently, according to the clinical condition and modality capabilities.

HEALTH ADVOCATE

- To promote adherence to hospital and international appropriateness criteria for neuroradiology.
- To participate and educate in awareness about the use and misuse of neuroradiology.

SCHOLAR

- To implement and monitor a self-personal continuing education strategy.
- To contribute to the development of new knowledge in neuroradiology.
- To develop competence in the evaluation and review of the medical literature.
- To develop the ability to be an effective teacher of neuroradiology to students, residents, technologists, and colleagues.

PROFESSIONAL

- To deliver the highest quality of care.
- To understand the ethical and medico-legal requirements of a neuroradiologist.

2.2. DIAGNOSTIC NEURO MRI ROTATION

Number of rotation weeks	First year	Second year	Total
	12	12	24

MEDICAL EXPERT

Fellow's Knowledge:

- To gain knowledge regarding the detailed and deep radiological anatomy of the brain and spine as observed using MRI.
- To understand the advanced physical principles and clinical use behind MRI sequences (spine echo, fast spin echo, echoplanar imaging, gradient sequence, etc.).
- To understand the role and application of susceptibility weighted imaging, spectroscopy, perfusion, diffusion.
- To understand patient preparation and image acquisition for dedicated MRI imaging techniques, such as MR Angio, MR CSF flow, MR DTI, MR spectroscopy, and MRI perfusion.
- To exhibit competency in the understanding and interpretation of the imaging findings and management of the following brain and spine emergencies:
  - Intracranial and spinal bleeding
  - Stroke
  - Infectious conditions
  - Pituitary apoplexy
  - Acute metabolic diseases
  - Cerebral edema
  - Cerebral venous thrombosis
  - Acute white matter diseases
  - Traumatic injury of the brain, skull, face, and neck
  - Traumatic spine injuries
  - Spinal cord compression
- To recognize unusual imaging presentations of common pathologies.
- To understand the imaging findings of the following common neurological disorders:
  - Common inflammatory diseases and idiopathic conditions
  - Common metabolic diseases
  - Common white matter diseases

- Common neoplasms
- Common infection
- Trauma
- Phakomatoses.
- Vasculitis
- Neurodegenerative disorders
- Dural/leptomeningeal processes
- Vascular/ischemic conditions
- Degenerative spine diseases
- Scoliosis

- To recognize the major differences and the advantages and disadvantages of 1.5 vs. 3 tesla.
- To recognize and recommend the most appropriate next step in patient management.
- To be involved in the direct supervision of examinations and in working with technologists to make necessary adjustments to parameters and protocols as the studies are being performed.

Fellow's Skills:

- To generate an appropriate opinion about complex imaging findings.
- To learn the indications and precautions for the use of a variety of MR sequences and contrast agents.
- To perform proper post-processing of imaging data and practice manipulating the imaging data at dedicated 3D workstations.
- To acquire and practice basic imaging informatics skills (fetching and transferring images to and from advanced visualization systems).

COMMUNICATOR

The fellow must listen effectively.

- To obtain the appropriate information during consultation with referring physicians to be able to make recommendations regarding the most appropriate modality and laboratory tests, as well as the management of patients.
- To discuss important information with patients/families and the healthcare team when needed.
- To be an efficient communicator with referring physicians, including when the results of an investigation or procedure should be urgently communicated.
- To counsel and obtain consent from high-risk patients for the use of iodinated and MRI contrast media for neuroradiology.

COLLABORATOR

- To supervise neuroradiology cases during regular working hours, to assure proper and timely imaging.
- To contribute effectively to other interdisciplinary team activities.

MANAGER

- To work efficiently in a healthcare organization.
- To help in assigning cases effectively and efficiently in various modalities according to the clinical condition and modality capabilities.

HEALTH ADVOCATE

- To promote adherence to hospital and international appropriateness criteria for neuroradiology.
- To participate and educate in awareness about the safety of MRI.

SCHOLAR

- To implement and monitor a self-personal continuing education strategy.
- To contribute to the development of new knowledge in neuroradiology.
- To develop competence in the evaluation and review of the medical literature.
- To develop the ability to be an effective teacher of neuroradiology to students, residents, technologists, and colleagues.

PROFESSIONAL

- To deliver the highest quality of care.
- To understand the ethical and medico-legal requirements of a neuroradiologist.

2.3 PEDIATRIC ROTATION

Number of rotation weeks	First year	Second year	Total
	0	4	8

MEDICAL EXPERT

Fellow's Knowledge:

- The fellow will learn the particular issues of neuroradiology that pertain to the differences between children and adults, particularly the issues related to radiation protection, sedation, and MR safety.
- To learn to evaluate pediatric brain development and the appropriate MR sequence to be used.
- To gain knowledge and evaluate ultrasound images of neuro-pediatric patients.
- To gain basic knowledge in reading fetal MRI.
- To obtain knowledge of the differential diagnostic possibilities among pediatric patients, as follows:
  - Congenital and developmental anomalies of the brain and spine, such as disorders of organogenesis and neural tube closure, midline anomalies, prenatal brain disorders, and dysplasia
  - Disorders of neuronal migration
  - Cerebellar malformation disorder and posterior fossa cystic disorders
  - Disorders of Phakomatoses

  - Seizure disorders
  - Metabolic/toxic disorder
  - Anoxic/hypoxic injury
  - White matter diseases
  - Congenital and acquired infectious conditions
  - Benign and malignant lesions
  - Vascular pathologies
- To understand and interpret the imaging findings and management of the brain, head and neck, and spine emergencies encountered in the pediatric population.

Fellow's Skills:

- To supervise the study and monitoring of the cases together with the technologist during scanning, to be able to add any sequence or study.
- To learn the indications and precautions for the use of a variety of CT scan modalities and pediatric MR sequences, as well as contrast agents.
- To perform proper post-processing of the imaging data.
- To acquire an approach to read pediatric studies.

COMMUNICATOR

- The fellow must listen effectively.
- To obtain the appropriate information during consultation with referring physicians, to be able to make recommendations regarding the most appropriate modality and laboratory tests, as well as the management of patients.
- To discuss important information with patients/families and the healthcare team when needed.
- To be an efficient communicator with referring physicians, including when the results of an investigation or procedure should be urgently communicated.
- To counsel and obtain consent from high-risk patients for the use of iodinated and MRI contrast media for neuroradiology.

COLLABORATOR

- To supervise neuroradiology cases during regular working hours, to assure proper and timely imaging.
- To contribute effectively to other interdisciplinary team activities.

MANAGER

- To work efficiently in a healthcare organization.
- To help assign cases to various modalities effectively and efficiently, according to the clinical condition and modality capabilities.

HEALTH ADVOCATE

- To promote adherence to hospital and international appropriateness criteria for neuroradiology.
- To participate and educate in awareness about the safety of MRI and contrast media.
- To participate and educate in awareness about radiation in pediatric imaging.

SCHOLAR

- To implement and monitor a self-personal continuing education strategy.
- To contribute to the development of new knowledge in pediatric neuroradiology.
- To develop competence in the evaluation and review of the medical literature.
- To develop the ability to be an effective teacher of neuroradiology to students, residents, technologists, and colleagues.

PROFESSIONAL

- To deliver the highest quality of care to all pediatric patients.
- To understand the ethics of pediatric imaging.

2.4 Neurovascular intervention rotation

Number of rotation weeks	First year	Second year	Total
	8	0	8

MEDICAL EXPERT

Fellow's Knowledge:

- To be able to utilize various types of contrast and acquire knowledge regarding their principles and safety, as well as learn the contraindications and treatment of contrast reactions and dose of contrast.
- To know what type of procedure is indicated for each disease or laboratory test.
- To recognize each needle, catheter, and guide wire type and their uses, as well as various types of selective angiographic methods and imaging techniques.
- To obtain knowledge about the angiographic appearance of the normal and vascular anatomy, as well as its variants, and the appearance of pathologies of the cerebral and spinal vasculature.
- To obtain basic knowledge regarding different therapeutic agents and their advantages/disadvantages in the treatment of vascular processes of the brain, spine, and head and neck.
- To acquire knowledge regarding the interpretation of the relevant laboratory tests needed for specific procedures.
- To obtain knowledge of contraindications to cerebral catheter angiography and to be able to choose and recommend alternative imaging modalities (CTA, MRA) and alternatives to iodinated contrast agents.
- To recognize and manage post-procedural complications and obtain knowledge of patient monitoring pre- and post-procedure.
- To learn the physics of basic fluoroscopy and ultrasound and recognize its artifacts.
- To understand the risks involved in common interventional techniques and their management.
- To recognize emergency conditions and their appropriate management.

Fellow's Skills:

- To know the basic technique for endovascular access.
- To know the technique of percutaneous biopsy and lumbar puncture.

- To learn and perform diagnostic angiography under supervision.
- To learn the assessment of the patient before and after the procedure.

COMMUNICATOR

- To obtain important information during consultation with referring physicians, to be able to make recommendations regarding the most appropriate laboratory tests and management of patients.
- To discuss appropriate information with patients/families when needed prior to any procedure.
- To counsel and obtain consent from patients for any neurointerventional procedures.
- To communicate the outcomes of interventional procedures satisfactorily with patients and their relatives, as well as the healthcare team.

COLLABORATOR

- To interact appropriately with referring physicians and health care professionals using a team-oriented approach aiming for excellent patient care.

MANAGER

- To supervise technical staff to ensure that appropriate support is provided during interventional procedures.
- To conduct or supervise quality assurance, including safety issues and economic considerations, for any procedure.

HEALTH ADVOCATE

- To be able to minimize radiation exposure doses during interventional procedures.

SCHOLAR

- To implement and monitor a self-personal continuing education strategy.
- To contribute to the development of new knowledge in interventional neuroradiology.
- To develop competence in the evaluation and review of the medical literature.
- To develop the ability to be an effective teacher of neuroradiology to students, residents, technologists, and colleagues.

PROFESSIONAL

- To deliver the highest quality of care, including the maintenance of patient dignity and privacy at all times
- To understand the ethics behind the interventional procedures.
- To obtain informed consent prior to all procedures.

2.5 head and neck imaging rotation

Number of rotation weeks	First year	Second year	Total
	12	12	24

MEDICAL EXPERT

Fellow's Knowledge:

- To recognize the detailed and complex radiological anatomy of the head and neck region, including the paranasal sinuses, neck, orbits, skull base, and temporal bone.
- To become familiar with the different pathologies in these areas and the best radiological management of such conditions.
- To understand the advanced physical principles and clinical use behind MRI and CT in the head and neck.
- To recognize unusual imaging presentations of common pathologies.
- To learn the differential diagnoses of the following temporal bone pathologies:
  - Traumatic injuries, such as temporal bone fracture, ossicular dislocation, temporal bone CSF leakage, and post-traumatic cephalocele
  - Infectious and inflammatory conditions
  - Congenital external canal malformation, including periauricular venous, lymphatic, and cystic malformation
  - Benign and malignant conditions
  - Ossicular prosthesis
  - Postoperative mastoid
  - Cochlear implants
  - Petrous apex pathologies
  - Intratemporal fascial nerve pathologies
  - Temporal bone vascular lesions
  - Syndromic conditions involving the temporal bone
- To learn the differential diagnoses of the following orbital pathologies:
  - Congenital lesions
  - Vascular lesions
  - Infectious and inflammatory lesions
  - Tumor-like lesions
  - Benign and malignant lesions
  - Traumatic orbits pathology
- To learn the differential diagnoses of the following nose and sinus pathologies:
  - Normal variants
  - Congenital lesions
  - Infectious and inflammatory lesions
  - Tumor-like lesions
  - Benign and malignant lesions
  - Traumatic pathologies
- To be able to list the differential diagnoses and pathologies involving:
  - The skull base
  - Various head and neck spaces
  - The cerebellopontine angle and internal auditory canal
  - The aerodigestive tract

- To become an expert in evaluating the lymph nodes in the head and neck and their associated pathologies.
- To be able to evaluate the neck vasculature and its pathologies and variants.
- To be able to evaluate the course, anatomy, and pathologies of cranial nerves. Moreover, to become familiar with the best radiological examinations for evaluating the cranial nerves.

Fellow's Skills:

- To generate an appropriate opinion about complex imaging findings.
- To perform common post-processing tasks for CT and MRI studies, including multi-planar reformations (MPR), maximum intensity projections (MIP), minimum intensity projections (Mini IP), and vessel analysis neck vasculatures.

COMMUNICATOR

- To obtain appropriate information during consultation with referring physicians, to be able to make recommendations regarding the most appropriate tests and/or management for patients.
- To discuss appropriate information with patients/families and the healthcare team, when needed.
- To understand the importance of communication with referring physicians, including an understanding of when the results of an investigation or procedure should be urgently communicated in emergency situations.

COLLABORATOR

- To consult effectively with other colleagues and healthcare professionals.
- To contribute effectively to other interdisciplinary team activities.

MANAGER

- To work efficiently in a healthcare organization.
- To help assign cases effectively and efficiently to various modalities according to the clinical condition and modality capabilities.

HEALTH ADVOCATE

- To promote adherence to hospital and international appropriateness criteria for neuroradiology.
- To participate and educate in awareness about the use and misuse of neuroradiology.

SCHOLAR

- To implement and monitor a self-personal continuing education strategy.
- To contribute to the development of new knowledge in neuroradiology.
- To develop competence in the evaluation and review of the medical literature.
- To develop the ability to be an effective teacher of neuroradiology to students, residents, technologists, and colleagues.

PROFESSIONAL

- To deliver the highest quality of care.
- To understand the ethical and medico-legal requirements of a neuroradiologist.

2.6 research rotation

Number of rotation weeks	First year	Second year	Total
	0	4	4

A dedicated 4-week, full-time rotation in research is conducted to focus on research progression and to enable the fellow to attend any research course, if needed. It is expected that the project will span more than one month. Therefore, the completion of the work should be performed in parallel with the subsequent rotations.

MEDICAL EXPERT

Goals:

- To demonstrate an understanding of the basic principles of research design, methodology, data analysis, and clinical epidemiology, as well as their advantages and disadvantages from the perspective of radiology.
- To become familiar with the ethical requirements of research and demonstrate an understanding of the responsible use of informed consent.
- To understand and practice appropriate methods for writing research manuscripts, data collection, and result analysis and discussion.
- To demonstrate awareness of the current research topics in radiology using the medical informatics systems available.
- To acquire the skills necessary for scientific presentations and public discussions.

Training Methods

- A dedicated one-month, full-time rotation in research is conducted.
- It is expected that the project will span more than one month. Therefore, the completion of the work should be performed in parallel with the subsequent rotations.
- The fellow must choose a supervisor who will help access the essential resources that will allow the appropriate understanding of research skills and periodically discuss the progress of the work.
- Attendance of dedicated courses or workshops that enhance research skills may be required by the program.
- The fellow must finish the research proposal by the end of the first six-month period, which should be accepted by the neuroradiology research committee.
- An oral abstract of the study results should be presented during the second year at the fellows Neuroradiology Research Day.
- The research paper should be submitted at least two weeks before the Neuroradiology Research Day.
- It is highly desirable for fellows to work on presenting the research results at national and/or international meetings and to strive to publish their work in indexed journals.

Evaluation

- Attendance of designated courses/lectures will be monitored and incorporated into the annual evaluation score.
- A panel scoring of the research abstract presentation will be conducted at the end of the second year, at the Neuroradiology Research Day. This will count as the rotation score for that month (Appendix 9).

COMMUNICATOR

- To demonstrate skills in conveying and discussing scientific research to scientific communities through posters, abstracts, teaching slides, manuscripts, or other scientific communications.
- To communicate and collaborate effectively with the research supervisor during the research period.

COLLABORATOR

To identify, consult, and collaborate with appropriate experts to conduct the research.

LEADER

- To demonstrate the ability to identify an area of research interest and a research supervisor, to engage in the scholarship of scientific inquiry and dissemination.
- To demonstrate the ability to utilize the available resources and regularly meet with an identified research mentor.
- To demonstrate the ability to set realistic priorities and to use time effectively, to optimize professional performance.
- To demonstrate an understanding of the cost-effective use of healthcare resources.

HEALTH ADVOCATE

- To recognize the contributions of scientific research to the improvement of the health of patients and communities.

SCHOLAR

- To demonstrate the ability to pose an appropriate research question, recognize and identify gaps in knowledge and expertise around this question, and formulate an appropriate study design to answer it.
- To demonstrate the ability to carry out the research outlined in the proposal.
- To demonstrate an ability for data collection, data analysis, and the preparation of an abstract and manuscript.
- To demonstrate the ability to identify areas for further research.

PROFESSIONAL

- To uphold ethical and professional expectations of research consistent with institutional review board guidelines, including the maintenance of meticulous data and the performance of ethical research.

- To demonstrate personal responsibility for setting research goals and working with a supervisor to set and achieve research timeline objectives.
- To publish accurate and reliable research results, with attention to appropriate authorship attribution criteria.
- To disclose potential financial conflicts of interest (including speaker fees, consultative relationships, etc.) as appropriate when engaging in, and disseminating research results.

3. Academic activities:

Trainees will achieve the competencies described in the curriculum through a variety of learning methods. There will be a balance of different modes of learning, from formal teaching programs to experiential learning.

3.1 TEACHING:

- The fellow must demonstrate the ability to instruct and guide residents by conducting unknown case tutorial sessions at least once a month, providing advice on imaging techniques and patient management, as well as conveying important teaching points during case readouts and reviews.
- The fellow will also exhibit the capability to assimilate information and data and organize them into concise formal educational presentations. Participation in preparing and moderating relevant clinical-pathological meetings will also be required.

3.2 DAILY ROUND

Goals:
- To develop competence in a short presentation of all cases that should be discussed in a scientific and informative fashion.
- To educate all junior staff, and monitor and review management decisions and their outcomes before discussion with consultants.
- To generate an appropriate description of the findings, differential diagnosis, and proper recommendations.

3.3 MULTIDISCIPLINARY MEETINGS:

For example:
- Neuro-oncology tumor board
- ENT board
- Epilepsy
- Neurology

Goals:
- To promote effective communication and sharing of expertise with peers and colleagues.
- To promote the acquisition of knowledge, provide experience in laboratory direction and management, and encourage fellows to assume a leadership role in the education of other physicians and allied health professionals.
- To provide the knowledge, technical skills, and experience necessary for the interpretation and correlation of radiological findings by the Neuroradiology Fellows.

3.4 MONTHLY NEURORADIOLOGY ACADEMIC DAY:

- This is held once a month and is organized by the local training committee. All fellows must attend. Attendance will be incorporated into an annual overall evaluation score. A minimum of 70% attendance is mandatory.
- Half of the day will be presented by the fellows (see the academic assignments) and include the presentation of an interesting case, journal club, or mini oral presentation.
- The second half of the day will be led by an assigned consultant neuroradiologist in a formal lecture or interactive session.
- Guests from neuroradiology-related specialties, such as neurology, neurosurgery, and ENT, may be invited.

3.5 ACADEMIC ASSIGNMENTS:

The Saudi Neuroradiology Fellowship is designed to be a well-balanced academic training program that requires participation in clinical, research, and educational aspects of neuroradiology; thus, some academic assignments are needed, such as journal clubs, case presentations, and mini oral presentations. These academic assignments will be conducted once per month within the monthly Neuroradiology Academic Day and the fellow must deliver at least six assignments. The evaluation of the academic assignments will be incorporated with the final yearly evaluation.

Goals:
- To produce fellows with the highest level of clinical expertise.
- To produce future leaders in academic neuroradiology.
- To develop the medical knowledge, skills, and attitudes that are necessary to evaluate, diagnose, and manage patients with brain, head and neck, and spine diseases properly.
- To show a desire to improve continually the medical knowledge of fellows and that of others.
- To improve interpersonal and communication skills.

3.4.1 JOURNAL CLUBS

A regional journal club meeting should be arranged with active participation by the fellow. Journal articles are preselected, and the activity is prepared and discussed by fellows under the supervision of a consultant or program director (Appendix 6).

Goals:
- To promote continuing professional development.
- To stay up-to-date with the latest literature.
- To disseminate information on, and develop arguments regarding neuro, brain, head and neck, and spine topics, among others.
- To ensure that professional practice is evidence based.
- To learn and practice critical appraisal skills.
- To provide an enjoyable educational and social occasion.

3.4.2 CASE PRESENTATION

During his/her monthly rotations, the fellow will select an unusual case or interesting case to present at a department meeting or regional meeting under the supervision of a consultant or program director (Appendix 3).

Goals:
- To develop a description of the findings.
- To develop a proper differential diagnosis for each problem.
- To formulate a diagnosis/plan for each problem.
- To demonstrate a commitment to improving case presentation skills by regularly seeking feedback on presentations.
- To perform a short presentation about the literature on the disease in question.

3.4.3 MINI ORAL PRESENTATION:

The Neuroradiology Fellow should present a neuroradiology topic that should be interesting and focus on the latest updates in the literature, including the latest imaging techniques, under the supervision of a consultant or program director (Appendix 7) (the selected topic should be approved by the program director and/or neuroradiology consultant prior to presentation). Some examples of the topics are:
- MRI sequence, advanced techniques, and artifacts in MRI and CT scan
- Neuroradiology trauma
- Vascular variation, diseases, malformation, and anomaly
- Extra-axial tumors
- Update in intra-axial tumors (WHO Classification of CNS tumors)
- Intracranial infections and inflammatory conditions
- White matter disorders
- Metabolic brain disorders
- Degenerative and iatrogenic brain disorders
- Congenital brain malformations
- Neurocutaneous syndromes
- Spinal tumors and tumor-like conditions
- Neck masses
- Temporal bone and TMJ: anatomy and pathology
- Orbital anatomy and pathology

Goals:
- To promote continuing educational and professional development.
- To stay up-to-date with the latest literature in the topic being presented.
- To train the fellows in preparing and presenting lectures and searching the literature for a specific topic.
- To share knowledge with other trainees, fellows, and staff physicians.

3.6 GRAND ROUNDS/GUEST SPEAKER LECTURES

A 30–60-min formal lecture is presented by fellows as an overview of a specific topic and is attended by all radiology staff at the training hospital.

Goals:
- To increase physician's medical knowledge and skills and, ultimately, improve patient care.
- To understand and apply the current practice guidelines in the field of neuroradiology.
- To describe the latest advances in the field of radiology and research.

4. Universal topics:

The following topics should be covered by all candidates during his/her residency; otherwise, the candidate should cover them during the fellowship program. These topics are as follows:

Intent:
These are high value, interdisciplinary topics of outmost importance to the trainee. The reason for delivering the topics centrally is to ensure that every trainee receives high quality teaching and develops essential core knowledge. These topics are common to all specialties.

Topics included here meet one or more of the following criteria:
- Impactful: these are topics that are common or life-threatening
- Interdisciplinary: hence topics that are difficult to teach by a single discipline
- Orphan: topics that are poorly represented in the undergraduate curriculum
- Practical: topics that trainees will encounter in hospital practice

Development and Delivery:

Core topics for PG curriculum will be developed and delivered centrally by the Commission through e-learning platform. A set of preliminary learning outcomes for each topic will be developed. Content experts, in collaboration with the central team, may modify the learning outcomes.

These topics will be didactic in nature with focus on practical aspects of care. These topics will have more content-heavy as compared to workshops and other face-to-face interactive session planned.

The suggested duration of each topic is 1.30 hours.

Assessment:

The topics will be delivered in a modular fashion. At the end of each Learning Unit there will be on-line formative assessment. After completion of all topics there will be a combined summative assessment in the form of context-rich MCQ. All trainees must attain minimum competency in the summative assessment. Alternatively, these topics can be assessed in a summative manner along with specialty examination.

Some ideas: may include case studies, high quality images, worked examples of prescribing drugs in disease states, and internet resources.

Module 1: Introduction

Hospital acquired infections (HAI)

At the end of the Learning Unit, you should be able to:
- Discuss the epidemiology of HAI with special reference to HAI in Saudi Arabia.
- Recognize HAI as one of the major emerging threats in healthcare.
- Identify the common sources and set-ups of HAI.
- Describe the risk factors of common HAIs such as ventilator associated pneumonia, MRSA, CLABSI, Vancomycin Resistant Enterococcus (VRE).
- Identify the role of healthcare workers in the prevention of HAI.
- Determine appropriate pharmacological (e.g., selected antibiotic) and non-pharmacological (e.g., removal of indwelling catheter) measures in the treatment of HAI.
- Propose a plan to prevent HAI in the workplace.

Module 2: Cancer

- **Principles of management of cancer**
- **Side effects of chemotherapy and radiation therapy**
- **Surveillance Follow-up of cancer patients**

Principles of Management of Cancer:

At the end of the Learning Unit, you should be able to:
- Discuss the basic principles of staging and grading of cancers.
- Enumerate the basic principles, (e.g., indications, mechanism, types) of
  1. Cancer surgery
  2. Chemotherapy
  3. Radiotherapy
  4. Immunotherapy
  5. Hormone therapy

Side Effects of Chemotherapy and Radiation Therapy:

At the end of the Learning Unit, you should be able to:
- Describe important side effects (e.g., frequent or life or organ threatening) of common chemotherapy drugs.
- Explain principles of monitoring of side-effects in a patient undergoing chemotherapy.
- Describe measures (pharmacological and non-pharmacological) available to ameliorate side-effects of commonly prescribed chemotherapy drugs.
- Describe important (e.g., common and life-threatening) side effects of radiation therapy.
- Describe measures (pharmacological and non-pharmacological) available to ameliorate side-effects of radiotherapy.

Surveillance and Follow-Up of Cancer Patients:

At the end of the Learning Unit, you should be able to:
- Describe the principles of surveillance and follow-up of patients with cancers.
- Enumerate the surveillance and follow-up plan for common forms of cancer.

- Describe the role of primary care physicians, family physicians, and similar others in the surveillance and follow-up of cancer patients.
- Liaise with oncologists to provide surveillance and follow-up for patients with cancer.

Module 5: Acute Care

- **Pre-operative assessment**
- **Post-operative care**

Pre-Operative Assessment:

At the end of the Learning Unit, you should be able to:
- Describe the basic principles of pre-operative assessment
- Preform pre-operative assessment in uncomplicated patient with special emphasis on :
  1. General health assessment.
  2. Cardiorespiratory assessment.
  3. Medications and medical device assessment.
  4. Drug allergy.
  5. Pain relief needs.

- Categorize patients according to risks

Post-Operative Care:

At the end of the Learning Unit, you should be able to:
- Devise a post-operative care plan including monitoring of vitals, pain management, fluid management, medications, and laboratory investigations.
- Hand-over the patients properly to appropriate facilities.
- Describe the process of post-operative recovery in a patient.
- Identify common post-operative complications.
- Monitor patients for possible post-operative complications.
- Institute immediate management for post-operative complications.

Module 7: Ethics and Healthcare

- **Occupational hazards of Health Care Workers (HCW).**
- **Ethical issues: treatment refusal; patient autonomy.**

Occupation Hazards of Health Care Workers (HCW):

At the end of the Learning Unit, you should be able to:
- Recognize common sources and risk factors of occupational hazards among the HCW.
- Describe common occupational hazards in the workplace.
- Develop familiarity with legal and regulatory frameworks governing occupational hazards among the HCW.
- Develop a proactive attitude to promote workplace safety.
- Protect yourself and colleagues against potential occupational hazards in the workplace.

Ethical issues: treatment refusal; patient autonomy:

At the end of the Learning Unit, you should be able to:
- Predict situations where a patient or family is likely to decline prescribed treatment.
- Describe the concept of 'rational adult' in the context of patient autonomy and treatment refusal.
- Analyze key ethical, moral, and regulatory dilemmas in treatment refusal.
- Recognize the importance of patient autonomy in the decision making process.
- Counsel patients and families declining medical treatment in the light of best interest of patients

5. Core Specialty Topics:

Knowledge:

1- Non-rotational topics

1.1 Modalities:

Goals:
- To become proficient in the physical principles, indications, setup, logistics, and performance of imaging modalities related to neuroradiology.
- To be knowledgeable in advanced protocols, techniques, artifacts, contraindications, and precautions related to the performance of these examinations.
- To become proficient at post-processing techniques of 3D data sets and functional studies utilizing dedicated workstations.

1.2 Contrast agents:

Goals:
- To acquire solid knowledge about different types of CT scan and MRI contrast media.
- To understand the clinical use of contrast media in neuroradiology examinations and their preparation, indications, methods of administration, precautions, contraindications, limitations, artifacts, and reactions.
- To become familiar with the risk factors for contrast-induced nephropathy (CIN) and methods for handling such cases.
- To become familiar with the risk factors for nephrogenic systemic fibrosis (NSF) and the methods to avoid such condition.
- To understand the issue of gadolinium retention in the brain and other parts of the body, the patients who are at higher risk, and which contrast agents are preferred to avoid this condition, as well as to become familiar with the initiatives taken toward this issue and the recent research results.
- To demonstrate the ability to conduct prophylaxis and initial management of moderate or severe contrast media reactions.
- To gain basic knowledge regarding new developments in the field of contrast media.
- To become familiar with the current standards and guidelines for the use of iodinated and MRI contrast media.

Training Methods:
- To take responsibility for the prescription and supervision of contrast media administration during the pertinent rotations.
- Attending related courses and/or workshops required by the program.
- Feedback from the training supervisors regarding the knowledge and skills of the trainee in the area of contrast media management.

Examples of useful reading materials:

- ACR Manual on Contrast Media. https://geiselmed.dartmouth.edu/radiology/pdf/ACR_manual.pdf
- Standards for intravascular contrast agent administration to adult patients.
- https://www.whatdotheyknow.com/request/140615/response/345461/attach/5/BFCR%2010%204%20Stand%20contrast%20pdf2010.pdf
- Protocol for the safe administration of iodinated contrast media in diagnostic radiology. Radiology Departments at Heart of England NHS Foundation Trust.
- http://www.heartofengland.nhs.uk/wp-content/uploads/Protocol-for-the-administration-of-iodinated-contrast-media-in-diagnostic-radiology-FINAL-VERSION-1.pdf

1.3 Anatomy & Physiology:

Goals:

- To master the essential anatomical details of the brain, spine, and head and neck and how these details are identified by imaging.
- To master the essential details of the physiological functions of the brain, spine, and head and neck and correlate imaging findings with clinical dysfunction.

1.4 CT & MR physics:

Goals:

- To understand the physical principals of CT and MRI, as well as the physics of the different CT techniques and MR sequences.
- To be able to recognize artifacts and suggest solutions to overcome them.

Skills and Procedures:

Goals:

- To become familiar with various major imaging equipment and their components.
- To practice the optimal techniques for high-quality examinations using ultrasound, CT, MRI, and fluoroscopy, including appropriate techniques for the following:
  - Patient screening
  - Patient preparation
  - Patient positioning
  - Contrast administration
  - Protocol application
  - Radiation exposure reduction and protection
- To demonstrate the effects of changes in imaging parameters on image quality and the factors that can help avoid imaging artifacts.
- To practice diagnostic angiography and assist in neuro-interventional procedures in the brain, spine, and head and neck.

Attitude: Will be emphasized, including adherence to medical and Islamic ethics and practices, as well as the maintenance of an attitude of continuing education and learning. Constructive interaction with senior staff, clinicians, and technical staff will be exercised. Attributes such as responsibility, dedication, cooperation, teamwork, and a solid work ethic will be reinforced through emphasis upon role models.

The fellows shall follow and adhere to the institutional policies and procedures of hospitals where they spend their rotations in.

6. Courses and workshops

The implementation of such projects will be based on logistic feasibility and equal opportunity for all Fellows and training centers across the Kingdom. For example:

- Advanced MRI technique
- Lumbar puncture
- Neurovascular simulation course

7. Trainee selected topics and self-directed learning:

- Fellows are encouraged to manage their time to conduct self-directed learning by utilizing hospital facilities, such as the library, PCs, etc.
- Fellows should become familiar with the major radiological journals and should review them critically on a regular basis.
- Maintenance of a personal portfolio (self-assessment, reflective learning, and personal development plan).
- Achieving personal learning goals beyond the essential, core curriculum.
- Reading, including web-based material.
- Reading journals.
- Attending national and international conferences.

ASSESSMENT

1. Purpose of Assessment

The purpose of the assessment system is to:

- Enhance learning by providing formative assessment and enabling trainees to receive immediate feedback, measure their own performance, and identify areas for development.
- Drive learning and enhance the training process by clarifying what is required of trainees and motivating them to ensure that they receive suitable training and experience.
- Provide robust, summative evidence that trainees are meeting the curriculum standards during the training program.
- Ensure that trainees are acquiring competencies within the domains of good medical practice.
- Assess trainees' actual performance in the workplace.
- Ensure that trainees possess the essential underlying knowledge, skills, and attitude required for their specialty.
- Identify trainees who should be advised to consider a career change.

2. Assessment Methods

The following assessment methods are used in the integrated assessment system:

2.1. Annual Formative Assessment:

The Components of Promotion Requirement

- The first-year fellow must score the passing mark according to SCFHS polices in order to be promoted from first year to second year in each of the following items (Appendix 4):
  1. Clinical oral exam
  2. Academic assignments
  3. Rotation Evaluations
  4. Logbook
- The second-year fellow must score the passing mark according to SCFHS polices in order to be promoted from first year to second year in each of the following items (Appendix 5):
  1. Academic assignments
  2. Research
  3. Rotation Evaluations
  4. Logbook

2.1.1 In-training evaluation report (ITER) for the first year:

1. ***Rotation Evaluations***
   - This assessment is conducted toward the end of each training rotation throughout the academic year.
   - The Fellow's performance will be evaluated jointly by relevant staff regarding the following competencies:
     1. Performance of the trainee during daily work.
     2. Performance and participation in academic and departmental activities.

- The end-of-rotation evaluation form must be completed within two weeks after the end of each rotation (preferably in an electronic format) and must be signed by at least two consultants. The program director will discuss the evaluation with the Fellow, as necessary. The evaluation form will be submitted to the Local Training Supervisory Committee of the SCFHS within four weeks after the end of the rotation (Appendix 1).
- Annual promotion depends on a satisfactory annual overall evaluation according to SCFHS polices for passing mark.

2. Logbook

All trainees are required to keep a logbook (Appendix 2) during training (electronic records are highly recommended).

The purposes of the logbook are to:

- Monitor trainees' performance on a continual basis.
- Maintain a record of the neuroradiology examinations and interventional procedures performed.
- Enable the trainee and supervisor to determine the learning gaps.
- Provide a basis of feedback to the trainee.

The Fellow is required to do a minimum required number of examination cases per month per rotation:

Rotation	Type of examination	Number of cases
CT scan	**Brain and spine (including CT angiography and venography)**	**375**
MRI	**Brain and spine**	**320**
	Advanced techniques (MR spectroscopy, functional MRI, MR perfusion, DTI)	**20**
Head & neck	**CT SCAN**	**200**
	MRI	**60**
Pediatric Neuroradiology	**All examinations**	**100**
Neuro-Intervention	**All examinations**	**20**

- The completed logbook will be countersigned by the program director.
- The logbook should be submitted a maximum of 4 weeks before the final written exam.
- Failure to submit the logbook shall be discussed with the program director and scientific committee.
- The completion of the logbook is included in the end-of-year total score for first- and second-year trainees.

3. Academic assignment:

Each fellow must conduct a scientific presentation (please refer to Academic Assignment in the Practice-Based Learning And Didactic Activities section) six times per one academic year and is evaluated by a qualified consultant according to an evaluation form submitted by the local training committee (Appendices 3, 6, and 7).

4. Clinical oral exam

This examination is solely for first-year fellows (F1) and takes place near the end of the first academic year. Successful completion of this important assessment is mandatory for the fellow to be promoted to the next level (F2). For further details on this section please refer to the general bylaws and executive policy of assessment (available online at www.scfhs.org).

2.1.2 In-training evaluation report (ITER) for second year:

1. Rotation Evaluations

- This assessment is conducted toward the end of each training rotation throughout the academic year.
- The Fellow's performance will be evaluated jointly by relevant staff for the following competencies:
  1. Performance of the trainee during daily work.
  2. Performance and participation in academic and departmental activities.
- The end-of-rotation evaluation form must be completed within two weeks after the end of each rotation (preferably in an electronic format) and must be signed by at least two consultants. The program director will discuss the evaluation with the Fellow, as necessary. The evaluation form will be submitted to the Local Training Supervisory Committee of the SCFHS within four weeks after the end of the rotation (Appendix 1).
- Annual promotion depends on a satisfactory annual overall evaluation according to SCFHS polices for passing mark.

2. Logbook

All trainees are required to keep a logbook (Appendix 2) during training (electronic records are highly recommended).

The purposes of the logbook are to:

- Monitor trainees' performance on a continual basis.
- Maintain a record of the neuroradiology examinations and interventional procedures performed.
- Enable the trainee and supervisor to determine the learning gaps.
- Provide a basis of feedback to the trainee.

The Fellow is required to do a minimum required number of examination cases per month per rotation:

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	Advanced techniques (MR spectroscopy, functional MRI, MR perfusion, DTI)	**20**
Head & neck	**CT SCAN**	**200**
	MRI	**60**
Pediatric Neuroradiology	**All examinations**	**100**
Neuro-Intervention	**All examinations**	**20**

- The completed logbook will be countersigned by the program director.
- The logbook should be submitted within a maximum of 4 weeks before the final written exam.
- Failure to submit the logbook shall be discussed with the program director and scientific committee.
- The completion of the logbook is included in the end-of-year total score for first- and second-year trainees.

3. Research

- All fellows are required to conduct at least one research project supervised by a qualified neuroradiology consultant during the training time (refer to research rotation under specific rotation-based competencies).
- In each academic year, one research day is held by the local training committee, during which the research project for each fellow is evaluated and scored by the qualified neuroradiology consultant according to an evaluation form submitted by the local training committee, as per SCFHS (Appendix 8).

4. Academic assignment

Each fellow must conduct a scientific presentation (please refer to Academic Assignment in the Practice-Based Learning And Didactic Activities section) six times per one academic year and be evaluated by a qualified consultant according to an evaluation form submitted by the local training committee (Appendices 3, 6, and 7).

2.2 Summative assessment:

2.2.1 Final Written Examination of Neuroradiology

Objectives:

- To determine the quantity and quality of the specialty knowledge base ranked as competent, so that the individual can be used as a referral source for the specialty.
- To use theoretical data to determine the candidate's ability to think logically, solve problems, apply basic medical science to clinical problems, and make judgments with valid comparisons.
- To screen candidates for the purposes of being allowed to take the final clinical examination.

Eligibility and rules:

- Successful completion of all training requirements according to the SCFHS policies and rules for eligibility for the final examination.
- For the rules and regulations of the exam, please refer to the general bylaws and executive policy of assessment (available online at www.scfhs.org).

Examination Format:

The exam format will be according to the SCFHS and SEC general bylaws and executive policy of assessment. An exam format may include:

A. Paper one comprises 100 Single Best Answer (SBA) MCQs (clinical scenarios with SBA among four options).
B. Paper two examination will include 10 neuroradiology stations. Each station may contain from 1–5 cases with 5–10 short-answer questions (SAQ).

Examination Blueprint outlines

- See Appendix 9 or refer to the updated blueprint in the SCFHS website.

2.2.2. Final clinical examination of neuroradiology fellowship

Objectives

- To determine the ability of the candidate to practice as a specialist and provide consultation in the general domain of his/her specialty for other healthcare professionals or other bodies that may seek assistance and advice.
- To ensure that the candidate has the necessary clinical competencies relevant to his/her specialty, including but not limited to history taking, physical examination, documentation, procedural skills, communication skills, bioethics, diagnosis, management, investigation, and data interpretation.
- All competencies contained within the specialty core curriculum are subject to inclusion in the examination.

Exam format

The exam format will be according to the SCFHS and SEC general bylaws and executive policy of assessment. An exam format may include 10 cases and images delivered in a Power Point presentation, as follows:

- Adult brain stations (3–5 cases).
- Pediatric station (1–2 cases).
- ENT stations (1–2 cases).
- Spine stations (1–2 cases).
- Neurovascular/INR stations (1 case)

Eligibility for the final clinical summative:

Passing the Saudi Neuroradiology Fellowship final written examination according to the SCFHS and SEC general bylaws and executive policy of assessment.

CERTIFICATION OF TRAINING COMPLETION:

To be eligible to apply for final specialty examinations, each trainee is required to obtain a Certification of Training-Completion." Based on the training bylaws and executive policy (please refer to www.scfhs.org), trainees will be granted "Certification of Training-Completion" once the following criteria are fulfilled:

a. Successful completion of all training rotations.
b. Completion of training requirements as outlined by the scientific council/committee of specialty (e.g., logbook, research, others).

CERTIFICATION

Candidates who pass the final written, objective structural clinical examination, “OSCE,” and the clinical oral examinations are awarded the “Saudi Fellowship Certificate in Neuroradiology,” as per the training bylaws and executive policy (please refer to www.scfhs.org).

SUGGESTED LEARNING RESOURCES

This list is intended for use as a study aid only. SCFHS does not intend the list to imply endorsement of these specific references, nor are the exam questions necessarily taken solely from these sources.

Textbooks

Fellows are expected to read significantly during all neuroradiology rotations. The following represents an incomplete list of suggested textbooks. Neuropathology and neurology textbooks are extremely valuable to learning neuroradiology. The following are examples of neuroradiology textbooks:

- The Amirsys series
  Imaging anatomy brain, head & neck and spine
  Diagnostic Imaging Brain
  Pediatric Neuroradiology
  Diagnostic imaging Head & Neck
  Diagnostic imaging Spine
- Neuroradiology: Key Differential Diagnoses and Clinical Questions, Juan E. Small, Pamela Schaefer
- Neuroradiology: The Requisites, David M. Yousem

Web resources:

- ASNR Neuro Curriculum--http://www.asnr.org/asnr-neurocurriculum-live
- Head Neck Brain Spine--- http://headneckbrainspine.com
- White Matter Atlas – DTI atlas for white matter tracts http://www.dtiatlas.org
- Skull Base Anatomy – Wayne State University http://www.med.wayne.edu/diagRadiology/Anatomy_Modules/axialpages/Home_Page.html
- E-Anatomy: Radiologic Atlas of the Human Body

Journals

American Journal of Neuroradiology -**www.ajnr.org**
Neuroradiology ***https://link.springer.com/journal/234***
RadioGraphics -***pubs.rsna.org/page/radiographics/fundamentals***
Neuroradiology Clinics of North America - **www.neuroradiology.theclinics.com**

APPENDICES

Appendix 1: Rotation evaluation form.
Appendix 2: Cases Logbook.
Appendix 3: Case presentation evaluation form.
Appendix 4: In-training evaluation report (ITER) for first year.
Appendix 5: In-training evaluation report (ITER) for second year.
Appendix 6: Journal club evaluation sheet.
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Appendix 8: Research evaluation form.
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Appendix 1: Rotation evaluation form

NEURORADIOLOGY FELLOW IN-TRAINING EVALUATION

Name: _____ No.: _____ Level of Training: F1 ☐ F2 ☐

Rotation: _____Date From: _____To: _____

Training center :

No.	CRITERIA	PERFORMANCE EXPECTATION					
		Unsatis factory (<5)	Below Average (5<6)	Meet (6-7)	Above Average (>7 - <9)	Outstanding (9-10)	Not Applicable
I	**Knowledge and Academic Activity**						
	1. Basic Science						
	2. Clinical Science						
	3. Current Literature						
	4. Participation in Scientific Activities						
	5. Research						
II	**Clinical and Technical Skills**						
	6. Organization of Work						
	7. Records and Reports						
	8. Interpretation and Utilization of Information						
	9. Clinical Judgment and Decision-Making						
	10. Indications for Procedures						
	11. Procedures and Operative Skills						
	12. Performance in Emergencies						
	13. Supervision and Consultations						
III	**Attitudes and Ethics**						
	14. Discipline and Reliability						
	15. Patient Relations						
	16. Inter-professional Relations						
	17. Ethical Standards						

Total Score: $\frac{Total\ Score}{No.of\ Evaluated} x\ 10 =$ ☐

Comments:

_____

_____

Name of Evaluator:_____ Signature:_____ Date:_____

Director :_____ Signature:_____ Date:_____

FELLOWSHIP TRAINING PROGRAM

Name of Fellow:_____ Signature:_____ Date:_____

Appendix 2: Cases Logbook

Appendix 2: Cases Logbook.

NEURORADIOLOGY FELLOWSHIP LOGBOOK

Name:	Level: F1☐ F2☐	Rotation:	Hospital:

Procedures Logbook						
No.	Date	MRN	Age / Gender	Procedure Name	Supervising Consultant	Comments

Director:_____
FELLOWSHIP TRAINING PROGRAM

Signature:_____

Date:_____

Appendix 3: Case presentation evaluation form

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Saudi Commission for Health Specialties

NEURORADIOLOGY SAUDI FELLOWSHIP
CASE PRESENTATION EVALUATION FORM

Name: **Level:F1☐ F2☐**

No.	Component	Marks	Candidate Score
Part-1- verbal presentation & performance	The talk was well organized and clear audible speech	5	
	The fellow communicated to the audience (e.g. eye contact)	5	
	Ability in answering questions directly and politely	5	
Part-2 presentation content	Picked a case that was challenging and interesting.	10	
	Exhibited a clear understanding of the case and its background material	10	
	The patient case hospital course well explained.	10	
	Result interpretation was informative and precise	10	
	Short literature review was helpful.	10	
	Presents an accurate summary and recommendation/s.	10	
	Clear "take home massage"	5	
Part-3- Slides and visual aids	The slides were clear and well organized.	5	
	Enough images relevant to the case was used.	5	
	Number and clarity of slides	5	
	Uses of figures, tables, etc. effectively	5	
	TOTAL SCORE	100	

NAME OF EVALUATOR:_____SIGNATURE:_____DATE:_____

Appendix 4: In-training evaluation report (ITER) for first year

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NEURORADIOLOGY SAUDI FELLOWSHIP FIRST YEAR IN TRANINING EVALUATION REPORT (ITER) FORM

Trainee Name:	**Trainee SCFHS No:**

	Yes	No
Evaluation covering the last year as a Fellow: In the Fellowship Program Committee's view, the trainee mentioned above has acquired the competencies of the Neuroradiology as prescribed in the Objectives of Training and is competent to practice as a specialist. (Please tick in the appropriate box)		

The following sources of information were used for this evaluation:

Items	Fellows mark from 100	**Clear Fail (<50), borderline fail (50-59.4), borderline pass (60-69.4) and clear pass (>70)**
Oral exams		
Rotation Evaluations		
Academic assignments		
Logbook		

Note: (in each item the fellow must get marks more or equal to 60)

Comments:

_____

_____

Director:_____ **Signature:**_____ **Date:**_____
FELLOWSHIP PROGRAM

Name of Trainee:_____ **Signature:**_____ **Date:**_____

Trainee's comment:

Appendix 5: In-training evaluation report (ITER) for second year

الهيئة السعودية للتخصصات الصحية
Saudi Commission for Health Specialties

NEURORADIOLOGY SAUDI FELLOWSHIP SECOND YEAR IN TRANINING EVALUATION REPORT (ITER) FORM

Trainee Name:	**Trainee SCFHS No:**

Evaluation covering the last year as a Fellow: In the Fellowship Program Committee's view, the trainee mentioned above has acquired the competencies of the Neuroradiology as prescribed in the Objectives of Training and is competent to practice as a specialist. (Please tick in the appropriate box)	Yes	No

The following sources of information were used for this evaluation:

Items	Fellows mark from 100	**Clear Fail (<50), borderline fail (50-59.4), borderline pass (60-69.4) and clear pass (>70)**
Research		
Rotation Evaluations		
Academic assignments		
Logbook		

Note: (in each item the fellow must get marks more or equal to 60)

Comments:

Director:_____ **Signature:**_____ **Date:**_____
FELLOWSHIP PROGRAM

Name of Trainee:_____ **Signature:**_____ **Date:**_____

Trainee's comment:

Appendix 6: Journal club evaluation sheet

الهيئة السعودية للتخصصات الصحية
Saudi Commission for Health Specialties

NEURORADIOLOGY SAUDI FELLOWSHIP
JOURNAL CLUB EVALUATION FORM

Fellow Name: **Level:F1☐ F2☐**

Name of Article:

-Describe the most positive aspect of the resident's presentation:

-Describe areas for further improvement:

No.	Component	Marks	Candidate Score
Part-1 Interpersonal & communication skills	The talk was well organized and clear audible speech	**5**	
	The fellow communicated to the audience (e.g. eye contact)	**5**	
	Ability in answering questions directly and politely	**5**	
Part-2 Medical knowledge	Picked an appropriately challenging article	**10**	
	Exhibited a clear understanding of the background material	**10**	
	Demonstrated a clear understanding of the contextual background for the study (e.g. Prior evidence, existing guidelines and recommendations).	**10**	
	Effectively and concisely summarizes the study design and methodology	**10**	
	Understanding the results	**10**	
	Clearly understood the conclusions	**10**	
	Presented an accurate summary and recommendation/s.	**10**	
Part-3 Slides & visual aids	The slides were clear and well organized.	**5**	
	Number and clarity of slides	**5**	
	Uses of figures, tables, etc. effectively	**5**	
	TOTAL SCORE	**100**	

NAME OF EVALUATOR:_____SIGNATURE:_____DATE:_____

Appendix 7: Mini oral presentation evaluation

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NEURORADIOLOGY SAUDI FELLOWSHIP
MINI ORAL PRESENTATION EVALUATION FORM

Fellow Name: **Level:F1☐ F2☐**

Name of Topic:

No.	Component	Marks	Candidate Score
Part-1- verbal presentation & performance	The talk was well organized and clear audible speech	**5**	
	The fellow communicated to the audience (e.g. eye contact)	**5**	
	Ability in answering questions directly and politely	**5**	
Part-2 Topic content	The subject matter was well selected and extensive.	10	
	Scientific information to the topic was adequate and relevant.	15	
	The fellow demonstrated a clear understanding of the subject.	10	
	Effective Interpretation of radiology images.	10	
	Excellent usage of reference from books and journals.	10	
	Presented an accurate summary and recommendation/s.	10	
	The subject matter was well selected and extensive.	10	
Part-3- Slides and visual aids	Organization of slides.	**5**	
	Adherence to time limit	**5**	
	Number and clarity of slides	**5**	
	Uses of figures, tables, etc. effectively	**5**	
	TOTAL SCORE	**100**	

Name Of Evaluator:_____Signature:_____date:_____

Appendix 8: Research evaluation form

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Saudi Commission for Health Specialties

NEURORADIOLOGY SAUDI FELLOWSHIP
RESEARCH PRESENTATION EVALUATION FORM

Fellow Name: **Trainee SCFHS number:**

RESEARCH TITLE:

No.	Component	Marks	Candidate Score	Comment
Part-1 Written text evaluation	1. Originality of topic	3		
	2. Abstract/summary	5		
	3. Aims and objectives	5		
	4. Literature review	6		
	5. Methodology	12		
	6. Results (data analysis, presentation)	12		
	7. Discussion, conclusion and recommendation	5		
	8. Ethical considerations	2		
	9. Style and structure of the text, tables, and diagrams	5		
	10. References	5		
	Total Written Evaluation	60		
Part-2 Defense	1. Presentation	30		
	2. Defense	10		
	Total Defense Evaluation	40		
	Total Cumulative Marks	**100**		

Comments:
_____
_____

Name Of Evaluator:_____Signature:_____date:_____

Appendix 9: Written Exam Blueprint

Blueprint outlines

No	Section	%
1	Imaging pathology	**50**
2	Basic Neurosciences	**20**
3	Technical and Imaging Physics	**10**
4	Clinical Neurosciences	**10**
5	Research, ethics and patient safety	**10**
	Total	**100**

Note:
Blueprint distributions of the examination may differ in each category.