



الهيئة السعودية للتخصصات الصحية  
Saudi Commission for Health Specialties

# INTERVENTIONAL NEURORADIOLOGY

Training Executive Administration  
Training Development Department  
Curriculum Development Section



\* This manual is meant to serve as a curriculum writing guide for members of the Curriculum Development Committee of SCFHS Accredited Postgraduate Training Programs.

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# PREFACE

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- The primary goal of this document is to enrich the training experience of postgraduate trainees by outlining the learning objectives to become independent and competent future practitioners.
- This curriculum may contain sections that outline specific training regulations. However, such regulations need to be sought from the “General Bylaws” and “Executive Policies” governing training, as published by the Saudi Commission for Health Specialties (SCFHS), which can be accessed online through the official SCFHS website. In case of discrepancies in regulation statements, the one stated in the most updated bylaws and executive policies should be applied.
- As this curriculum is subject to periodic refinement, please refer to the electronic version posted online for the most updated edition at: [www.scfhs.org.sa](http://www.scfhs.org.sa)

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## II. COPYRIGHT STATEMENTS

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## III. FOREWORD

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The Interventional Neuroradiology Fellowship curriculum development team acknowledges the valuable contributions and feedback from the scientific committee members in the development of this program. We extend special appreciation and gratitude to all members who have been pivotal to the development and publication of this booklet, especially the Curriculum Group, Curriculum Specialists, and Scientific Council. We would also like to acknowledge that many of the competency descriptions used in this resource was acquired from the Canadian Medical Education Directives for Specialists (CanMEDS) framework of the Royal College of Physicians and Surgeons of Canada with permission.



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# V. INTRODUCTION

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## 1. Context of Practice

Interventional Neuroradiology is a major subspecialty of neuroradiology that covers all related vascular and non-vascular pathologies of the central nervous system (i.e., brain, spinal cord, spine, and surrounding structures), extracranial head and neck vascular and non-vascular pathologies, and pain management.

The development of endovascular techniques has made Interventional Neuroradiology (INR) the first option for the diagnosis and treatment of most vascular diseases of the central nervous system<sup>1</sup>

Interventional neuroradiologists provide and deliver the highest standard of care for patients using the latest minimally invasive treatment techniques in imaging guidance, which replace major conventional open neurosurgical procedures, adjuvant therapy, or primary treatment options for specific diseases.

There is huge variation in interventional neuroradiology practice globally owing to the unique situation and challenges in each country and institution<sup>1</sup>. Our regional demographic variations and large spectrum of disease patterns mandate the necessity of our own local interventional neuroradiology fellowship program, which is tailored according to our own patient population. Meanwhile, we are keen to ensure that the standard of our local fellowship program is comparable to the high standards of well-established guidelines for international credentialing<sup>2</sup>.

There is currently an extreme shortage of well-trained Interventional Neuroradiologists, not only in the Kingdom of Saudi Arabia, but also worldwide. In Saudi Arabia, local fellowship programs to support training for this high-demand specialty is lacking. It is important to develop local training programs to meet the growing demand for Interventional Neuroradiologists. It is particularly important for our region to support the needs of our aging population. The current demand is high and is expected to be even higher, given the exponential population growth, as well as the existence of new modalities for treating CNS vascular disorders and stroke<sup>3</sup>.

## 2. Goals and Responsibilities of Curriculum Implementation

The curriculum is designed to guide fellowship training programs. The main purpose of the curriculum is to provide structured training for prospective fellows to become independent and competent Interventional Neuroradiologists at the end of their fellowship training. Accordingly, this goal requires significant effort and coordination from all stakeholders involved in postgraduate training. The fellows must be proactive and fully engaged. They are expected to display the characteristics of adult learners including a careful understanding of learning objectives, self-directed learning, problem solving, an eagerness to apply learning by means of reflective practice from feedback and formative assessments, self-awareness, and the willingness to ask for and accept support when needed. The Program Director plays a vital role in ensuring the successful implementation of this curriculum. Moreover, training committee members, particularly program administrators, significantly affected program implementation. Fellows should be called on to share the responsibility for curriculum implementation. The Saudi Commission for Health Specialties (SCFHS) applies the best training governance models to achieve the highest training quality. The Academic Affairs departments of the training centers and regional supervisory training committees both contribute significantly to training supervision and implementation. The Interventional Neuroradiology Scientific Committee guarantees that the curriculum content is constantly updated to match the highest international standards in postgraduate education.



## VI. ABBREVIATIONS USED IN THIS DOCUMENT

Abbreviation	Description
SCFHS	Saudi Commission for Health Specialties
F1	(first) year of Fellowship
F2	(second) year of fellowship
PT	Progress test
OSCE	objective structured clinical examination
OSPE	objective structured practical examination
Mini-CEX	mini-clinical experience report
DOPS	direct observation of procedural skills report
CBD	case-based discussion report
CBE	competency-based education
ITER	in-training evaluation report
COT	consultation observation tool
RTC	Residency Training Committee
INR	interventional neuroradiology
CT	computed tomography
MRI	magnetic resonance imaging

Abbreviation	Description
CNS	central nervous system
DAVF	dural arterio-venous fistula



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# VII. PROGRAM ENTRY REQUIREMENTS

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The fellowship program ensures a robust and unbiased selection process. To be accepted into the training program, candidates are required to meet the following requirements:

- 1- Successful completion of accredited training, certified and accredited by the SCFHS or its equivalent, in any of the following programs:
  - Diagnostic Neuroradiology Fellowship
  - Neurology Residency Program
  - Neurosurgery Residency Program
- 2- Successful completion of an interview.
- 3- Provision of three letters of recommendation from consultants with whom the candidate has recently worked for a minimum of six months.
- 4- Written permission from the candidate's sponsoring institution to support the candidate in the full-time requirements of the curriculum during the entire program.
- 5- Payment of the SCFHS annual registration fee.

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# VIII. LEARNING AND COMPETENCIES

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## 1. Introduction to Learning Outcomes and Competency-Based Education

During the fellowship training, fellows must fulfil certain graded responsibilities. Upon completing the Interventional Neuroradiology Fellowship Program, fellows are expected to be competent in delivering neurointerventional services of the highest standards, underpinned by a strong professional foundation in providing safe and reliable decision-making, knowledge, and skills in both endovascular and nonvascular procedures to ensure optimal patient care.

The INR Fellowship Program will provide trainees with sufficient and comprehensive interventional neuroradiology practices that include the performance of neuro-interventional procedures of the vascular (arterial and venous) system, as well as diagnostic and invasive non-vascular procedures related to the CNS, spine, spinal cord, and the head and neck.

The fellow will undergo extensive training in fluoroscopic angiographically guided CT, MRI, and ultrasound-guided INR procedures and will learn the fundamentals of radiation safety and appropriate utilization of the machines and environment. The trainee will be expected to conduct pre-procedural patient evaluations, participate in the INR clinic and inpatient rounds, perform INR procedures under the supervision of consultants, and ensure patient care during the immediate post-procedure period.



The teaching comprises individual case discussions, emphasizing the importance of the decision-making process, planning and performing the procedure, and patient follow-up. Case discussions will be evidence-informed by pertinent literature, and the reviews of recommended texts and other materials.

The fellow will have the opportunity to perform non-invasive vascular imaging including CTA, MRA ultrasound, Doppler, and vascular labs. Experience in CT and MR angiographic procedures and opportunities for the post-processing of studies at dedicated workstations will also be provided to the trainees.

The fellow will gain familiarity with all neurointerventional tools, materials, and products. They are expected to appropriately select and utilize these for each patient and understand the techniques and/or procedures involved in using each tool, material, and product. In addition to dedicated lectures and clinical training, the fellow will have access to an interventional neurosimulation system to practice routine and complex procedures.

During the training period, the fellow will develop radiation safety skills and implement these skills to ensure patient safety, as well as safety to self and others involved, such as the managing team.

## 2. Program Durations

Interventional Neuro-Radiology Fellowship is a two-year training program.

## 3. Program Rotation

### The First and Second Year of Fellowship:

The continuum training process was primarily based on weekly scheduled assignments with a graded responsibility. The fellows are expected to work together. Junior F1 fellows will initially be involved in the preprocedure workup, consent, and post operative care. They will gradually be exposed to simple procedures including diagnostic cerebral angiography. As training progresses, fellows will become increasingly involved in interventional procedures, with the aim of becoming primary operators as they transition to senior fellow positions. In addition to routine daywork, fellows participate in on-call rosters that are shared among available fellows. The fellows will also be involved in elective procedures and emergency procedures. The direct hands-on experiences will be graded based on the competency of each individual.

During the two-year fellowship program, fellows will work with other related clinical specialties and participate in rotations in neurosurgery, neurology, and the neuro-ICU. To gain experience in pre-and post operative management of patients with neurovascular pathologies, fellows will have a total of 4-week exposure to the Neuro-ICU during the two-year fellowship. During the fellowship, the fellow will also have four weeks of dedicated research time, and an opportunity for an additional 4-weeks of elective rotations. Fellows are also entitled to 4 weeks of annual vacation.

Interventional Neuroradiology Rotations:

Interventional Neuroradiology service/weeks	First year	Second year	Total
	40	40	80
Neuro-ICU rotation	4	-	4
Research time	-	4	4
Elective rotation	4	4	8
Annual vacation	4	4	8

\* Includes four weeks of annual vacation to be taken at any time during each year

## 4. Mapping of Learning Objectives and Competencies to Program Rotations:

### Goal:

After completion of the INR Fellowship Program, trainees graduate as subspecialty consultants with core competencies in Interventional Neuroradiology as per the SCFHS regulations.

### Mapping of Training Milestones and the Continuum of Learning:

The INR fellow is required to perform a minimum number of procedures as the primary operator. These cases are distributed throughout the academic years in line with the fellow's growth and development. The complexity of each case is





considered to optimize the learning experience for the fellow, while also ensuring maximum patient safety. The chronological growth of the INR fellow, from junior level to senior level, is monitored by the local fellowship Program Director on a quarterly basis to ensure proper compliance with requirements and to match the training goals as the fellow progresses.



*Junior-level to Senior-level Competency-Matrix: Mapping Competency, Learning Domain,s and Milestones*

Training year level	Competency (With annotation of the relevant learning domains: K = knowledge, S = skills A = attitude)	K: Deep understanding of the neuroanatomy, neurovascular embryology, and the timing when specific neurovascular malformations occur during development	S: The fellow is expected to explain and specify the major vascular anomalies and classify them	A: Under the supervision of senior colleagues and assigned neuro-interventional staff	Demonstrate chronological growth in INR skills based on periodic assessment	Assessments during rotations
F1/F2	Diagnostic angiograms	Carotid, cerebral, vertebral, and complete spinal angiograms	The fellow is expected to perform diagnostic cerebral angiograms and be able to identify normal anatomy and normal variants.	The fellow is expected to maintain positive professional and personal attitude during each rotation. Eagerness to learn under the supervision of senior colleagues and assigned neuro-interventional staff should be evident.	300 cases	DOPS
	Acute ischemic stroke management	K: be able to select the candidates for acute stroke management	The fellow will be able to identify patients who are suitable for acute ischemic stroke intervention. The fellow will select the	The fellow is expected to maintain positive professional and personal attitude during the rotation. Eagerness to learn under the supervision of senior colleagues and assigned	60 cases	CBD, DOPS, EA



			best recanalization method for each patient.	neuro-interventional staff should be evident.		
	<b>Hemorrhagic stroke management (aneurysms)</b>	K: Be able to accurately diagnose the type and source of hemorrhagic stroke	The fellow will be able to identify appropriate candidates for surgical and endovascular management. The fellow will select appropriate management strategies for each case.	The fellow is expected to maintain positive professional and personal attitude during the rotation. Eagerness to learn under the supervision of senior colleagues and assigned neuro-interventional staff should be evident.	50 cases	CBD, DOPS
	<b>Extracranial and intracranial angioplasty and stenting</b>	K: Be able to accurately diagnose the type	The fellow will be able to identify eligible cases for management and demonstrate effective skills in stenting.	The fellow is expected to maintain positive professional and personal attitude during the rotation. Eagerness to learn under the supervision of senior colleagues and assigned neuro-interventional staff should be evident.	30 cases	CBD
	<b>Brain, spine, and head-neck arteriovenous malformations</b>	K: Be able to accurately diagnose the type and source of hemorrhagic stroke	The fellow will be able to identify patients who are suitable for	The fellow is expected to maintain positive professional and personal attitude during the rotation.	30 Cases	CBD, DOPS

			interventional management and be able to safely perform the embolization.	Eagerness to learn under the supervision of senior colleagues and assigned neuro-interventional staff should be evident.		
	Spine pain management	K: Be able to accurately diagnose the type	The fellow will be able to identify patients who are suitable for interventional therapy and be able to safely perform the indicated spine pain procedures.	The fellow is expected to maintain positive professional and personal attitude during the rotation. Eagerness to learn under the supervision of senior colleagues and assigned neuro-interventional staff should be evident.	20 cases	DOPS
	DAV fistula malformation endovascular embolization	K: Be able to accurately diagnose the type of DAF	The fellow will be able to identify patients who are suitable for embolization and perform the procedure safely.	The fellow is expected to maintain positive professional and personal attitude during the rotation. Eagerness to learn under the supervision of senior colleagues and assigned neuro-interventional staff should be evident.	20 Cases	CBD, DOPS



	<b>Percutaneous sclerotherapy</b>	K: Be able to accurately diagnose the type of the low flow vascular malformations in the head and neck	The fellow will be able to identify patients who are suitable for sclerotherapy and perform the procedure safely.	The fellow is expected to maintain positive professional and personal attitude during the rotation. Eagerness to learn under the supervision of senior colleagues and assigned neuro-interventional staff should be evident.	20 cases	DOPS
	<b>Research</b>	Develop and submit a minimum of 1 paper	The fellow will be able to choose a research topic within his 1 <sup>st</sup> 6 months of fellowship, meet with the research team frequently, collect data and write and submit at least 1 research paper.	The fellow is expected to maintain positive professional and personal attitude during the rotation. Eagerness to learn under the supervision of senior colleagues and assigned neuro-interventional staff should be evident.	1 paper	Minimum of one paper during fellowship
	<b>Neuro-ICU rotation</b>	Be familiar with the pre- and post-procedural processes for the care of patients with neurovascular conditions.	The fellow will participate in Neuro-ICU morning rounds and discuss the management of critical	The fellow is expected to maintain positive professional and personal attitude during the rotation. Eagerness to learn under the supervision of	20 cases	The formative assessment of this rotation is mapped

			patients with neurovascular conditions with the Neuro-ICU attendings.	senior colleagues and assigned neuro-interventional staff should be evident.		ed with the Neuro-ICU “outside rotation”.
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## Interventional Neuroradiology Service Rotation:

### MEDICAL EXPERT

**Knowledge:** By the end of the fellowship, the fellow will be able to:

- Safely utilize various types of contrasts at the appropriate dosages, be knowledgeable regarding the underlying principles and safety, risks and contraindications, and be competent in the treatment of contrast reactions.
- Recognize the type of INR procedure that is indicated for each disease or laboratory test.
- Recognize the different needle, catheter, and guidewire types and be familiar with their uses.
- Recognize and appropriately apply various types of selective angiographic methods and imaging techniques.
- Identify the angiographic appearance of the normal and vascular anatomy, as well as its variants.
- Identify pathologies of the cerebral and spinal vasculature.
- Differentiate between therapeutic agents including their advantages and disadvantages in the treatment of vascular processes in the brain, spine, head, and neck.
- Interpret relevant laboratory tests needed for specific procedures.
- Recognize contraindications to cerebral catheter angiography and choose and recommend alternative imaging modalities (CTA and MRA) and iodinated contrast agents.
- Recognize and manage post-procedural complications and acquire patient monitoring skills, including the pre- and post-procedure processes.



- Demonstrate in-depth knowledge of the physics involved in basic fluoroscopy and ultrasound, and recognize the artifacts.
- Identify the risks associated with common interventional techniques and be proficient in their management.
- Recognize emergency conditions and manage them appropriately.

**Skills: By the end of the fellowship, the fellow will be able to:**

- Assess the patient before and after each procedure.
- Perform the basic technique for endovascular access.
- Perform diagnostic angiography.
- Perform simple and complex interventional neuroradiology procedures including stroke mechanical thrombectomy and aneurysm treatment.
- Perform other non-vascular neuroradiology procedures including percutaneous spine procedures.

**Communications: By the end of the fellowship, the fellow will be able to:**

- Obtain and synthesize important information during consultation with referring physicians to make recommendations regarding the most appropriate laboratory tests and patient management.
- Discuss relevant and appropriate information with patients and their families/relatives as indicated prior to a procedure.
- Counsel patients regarding any neurointerventional procedures.
- Obtain informed consent from patients before performing any neurointerventional procedures.
- Communicate the outcomes of any interventional procedures to patients and their families/relatives
- Communicate the outcomes of any interventional procedures with the healthcare team.

**Collaboration: By the end of the fellowship, the fellow will be able to:**

- Interact with referring physicians and other healthcare professionals professionally, cooperate using a team-oriented approach, with the aim of delivering excellent patient care.

**Management:** By the end of the fellowship, the fellow will be able to:

- Supervise technical staff to ensure that appropriate support is provided during interventional procedures.
- Conduct or supervise quality assurance including safety audits, economic considerations, etc. for any procedure.

**Health advocacy:** By the end of the fellowship, the fellow will be able to:

- Minimize radiation exposure doses during interventional procedures.
- Discuss the risks and benefits of intervention and non-intervention with the patients and their families/relatives.

**Scholarship:** By the end of the fellowship, the fellow will be able to:

- Implement and monitor a self-directed continuing education strategy.
- Contribute to the development of new knowledge in interventional neuroradiology.
- Evaluate and review of the medical literature competently.
- Share Interventional neuroradiology knowledge with others and engage in teaching students, residents, technologists, and colleagues.

## MEDICAL PROFESSIONAL

By the end of the fellowship, the fellow will be able to:

- Deliver the highest quality of care, upholding patient dignity and privacy.
- Consider the ethical aspects that are important to the provision of interventional procedures.
- Obtain informed consent prior to all procedures.

## RESEARCH ROTATION

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

The dedicated 4-week, full-time rotation in research aims to support the fellow to ensure research progression and enable the fellow to attend any research courses if needed. As the research project is expected to last more than one month, the completion of the work should be performed in parallel with subsequent





rotations. Fellows are required to develop and submit at least one (1) research manuscript in Interventional Neuroradiology during their training program. The manuscript must be submitted to a peer-reviewed scientific journals for publication consideration.

## MEDICAL EXPERT

By the end of the fellowship, the fellow will be able to:

- Demonstrate the basic principles of research design, methodology, data analysis, and clinical epidemiology, and understand their advantages and disadvantages from a radiology perspective.
- Apply ethical research requirements and demonstrate appropriate informed consent procedures.
- Demonstrate skills in research protocol development, data collection, data analysis, result discussion, and manuscript development.
- Demonstrate comprehensive awareness of current research topics in radiology including the use of available medical informatics systems.
- Deliver oral presentations at scientific events and public discussion forums with confidence

## COMMUNICATOR

By the end of the fellowship, the fellow will be able to:

- Present and discuss scientific research with scientific communities through posters, abstracts, teaching slides, manuscripts, or other scientific communication media.
- Communicate professionally and collaborate effectively with the research supervisor during the research period.

## COLLABORATOR

By the end of the fellowship, the fellow will be able to:

- Identify, consult, and collaborate with appropriate experts to conduct research.

## LEADER

By the end of the fellowship, the fellow will be able to:

- Identify an area of research interest and research supervisors to engage in scholarship on scientific inquiry and dissemination.
- Utilize the available resources and regularly meet with an identified research mentor.
- Set realistic priorities and to use time effectively, to optimize professional performance.
- Recognize the cost-effective use of healthcare resources.

## HEALTH ADVOCATE:

By the end of the fellowship, the fellow will be able to:

- Recognize the contributions of scientific research in improving the health of patients and communities.

## SCHOLAR

By the end of the fellowship, the fellow will be able to:

- Pose an appropriate research question, recognize and identify gaps in knowledge and expertise around the question, and formulate an appropriate study design to answer it.
- Carry out the research outlined in the proposal.
- Collect and analyze data and prepare an abstract and manuscript.
- Identify areas for further research.



## PROFESSIONAL

By the end of the fellowship, the fellow will be able to:

- Demonstrate the ethical and professional expectations of research consistent with institutional review board guidelines including the maintenance of meticulous data and the performance of ethical research.
- Demonstrate personal responsibility for setting research goals and work with a supervisor to set and achieve research timeline objectives.
- Publish accurate and reliable research results, with attention to appropriate authorship attribution criteria.
- Disclose potential financial conflicts of interest (including speaker fees and consultative relationships) when engaging in and disseminating research results.

# IX. CONTINUUM OF LEARNING

The continuum of learning refers to the learning that occurs at each key stage of progression within the INR specialty. Trainees are expected to engage in continuous lifelong professional development (CPD). Trainees are encouraged to keep in mind the necessity of CPD for every healthcare provider in order to meet the demands of their profession. The following table shows how this role is progressively expected to develop throughout the junior, senior, and consultant levels of practice.

*For Fellowship programs:*

Specialty General Practice	F1 (Junior Level)	F2 (Senior Level)	Consultant subspecialist
Sub- specialty non-practicing	Dependent/ supervised practice	Dependent/supervised practice	Independent practice/provide supervision
Obtain basic health science and foundational level to core discipline knowledge	Obtain fundamental knowledge related to core clinical problems of the specialty	Apply knowledge to provide appropriate clinical care related to core clinical problems of the specialty	Acquire advanced and up-to-date knowledge related to core clinical problems of the specialty
Internship to the practice of discipline	Apply clinical skills such as physical examination and practical procedures related to the core presenting problems and procedures of the specialty	Analyze and interpret the findings from clinical skills to develop appropriate differential diagnoses and management plan for the patient	Compare and evaluate challenging, contradictory findings and develop expanded differential diagnoses and management plan



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# X. TEACHING METHODS:

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The teaching process in postgraduate fellowship training programs is primarily based on the principles of adult learning theory. The trainees appreciate the importance of learning and actively engages in the knowledge content and process of their own learning. The training program's activities are all underpinned by the adult learning concept. Hence, students are responsible for their own learning requirements. Formal training time include the following two formal teaching activities:

- Program-specific learning activities
- General learning opportunities

## 1.1. Program-specific learning activities:

Program-specific activities are educational activities specifically designed for trainees and are essential components of their training. Trainees are required to attend these activities. Noncompliance may lead to disciplinary actions. It is advisable to link attendance and participation in these activities using a continuous assessment tool (see the formative assessment section below). Program administration should support these activities by providing protected time for trainees to attend and allow them to participate.

### A) Weekly INR academic half day

- These sessions are organized by a local training committee and held weekly. All fellows must attend. Attendance contributes to overall annual evaluation score. A minimum attendance rate of 70% is mandatory.

- Half of the day involves fellow-directed presentations, such as presenting an interesting case, facilitating a journal club, or delivering a mini-oral presentation. A minimum of six (6) journal club presentations and four (4) lectures per year are mandatory.
- The second half of the day is led by an assigned INR consultant. This may be a formal lecture or an interactive session.
- Guests from interventional neuroradiology-related specialties, such as neurology, neurosurgery, and ENT may be invited.

## B) Teaching

- Fellows must demonstrate the ability to instruct and guide residents by conducting tutorial sessions on unknown cases at least once a month, providing advice on imaging techniques and patient management, and conveying important teaching points during case readouts and reviews.
- The fellows must also demonstrate the ability to assimilate information and data, and organize relevant findings into concise formal educational presentations. Participation in preparing and moderating relevant clinicopathological meetings is also required.

## C) Daily clinical rounds

- To develop competence through a short presentation of all cases that should be discussed in a scientific and informative manner.
- Educate all junior staff, and monitor and review management decisions and outcomes before discussions with consultants.

## D) Multidisciplinary meetings

- Fellows must actively participate in interventional clinical-radiological meetings (e.g., stroke meetings and neurovascular tumor board meetings). A minimum attendance of 70% is mandatory.

## 2.1. General Learning Opportunities:

Formal training time should be supplemented by other practice-based learning (PBL) methods, such as

- Journal club
- Weekly stroke rounds
- Daily neurovascular group rounds.



- Monthly neurovascular board meetings
- Grand rounds
- Involvement in quality improvement committees and meetings
- Continuous professional activities (CPD) relevant to the specialty (e.g., conferences and workshop)
- Morbidity and mortality (M&M) meetings\*

\* The M&M conferences offer trainees the opportunity to discuss cases with adverse outcomes due to errors or complications. The goal is to refocus the content of morbidity and mortality for teaching patient safety principles and emphasizing error-reduction strategies.

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# XI. ASSESSMENT AND EVALUATION

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## 1. The Purpose of Assessment

Assessments play a vital role in the success of postgraduate training. Assessment guides trainees and trainers to achieve defined standards, learning outcomes, and competencies. Assessments also provide feedback to learners and faculty regarding curriculum development and implementation, teaching methods, and the quality of the learning environment. A reliable and valid assessment is essential for assessing curriculum alignment with respect to objectives, learning methods, and assessment tools. Finally, the assessment assures patients and the public that health professionals are safe and competent.

## 2. Formative Assessment

### 2.1 General Principles

Trainees, as adult learners, should strive to seek, and develop their performance based on feedback obtained throughout their journey acquiring competency, from “novice” to “mastery”. Formative assessment (also referred to as continuous assessment) is the component of assessment that is distributed throughout the academic year, aiming primarily to provide trainees with effective feedback.

Every 12 weeks, at least one hour should be assigned for trainees to meet with their Program Director (or equivalent) to review performance reports (e.g., ITER, logbook, workplace-based assessment tools, etc.). Input from the overall formative assessment tools is utilized at the end of the year to determine whether individual trainees will be promoted from the current to the subsequent training level. Formative assessment tools are defined based on scientific committee recommendations, which are usually updated and announced for each individual program at the start of the academic year.

According to the executive policy on formative assessment (available online at [www.scfhs.org](http://www.scfhs.org)), formative assessment has the following features which will be used based on targeted competencies:

- a. Multisource: minimum of three tools including a relevant workplace-based tool





- b. Comprehensive: covering all learning domains (knowledge, skills, and attitude).
- c. Relevant: focusing on workplace-based observations.
- d. Milestone-oriented competency: reflecting the trainee's expected competencies as aligned with the trainee's developmental level.

Trainees should actively seek feedback during training, and trainers should provide timely and formative assessments. The SCFHS provides an e-portfolio system to enhance the communication and analysis of data from formative assessments.

Trainers and trainees are expected to follow the recommendations of the Scientific Council regarding the updated forms, frequency, distribution, and deadlines related to the implementation of evaluation forms.

## 2.2 Formative Assessment Tools

### Purpose of formative Assessment

- Enhance learning by providing formative assessments, enabling residents to receive immediate feedback, measure their performance, and identify areas for development and improvement.
- Drive learning and enhance the training process by clarifying what is required of residents and motivating them to ensure they receive suitable training and experience.
- Provide robust, summative evidence that residents are meeting the curriculum standards during the training program.
- Ensure that residents acquire competencies within the domain of good medical practice.
- Ensure that residents possess the essential underlying knowledge, skills, and attitude required for their specialty.

Gen./Sub.	Level	Knowledge Skills Attitude												
		SOE	EYPT-n't	Academic Activities	CBD	EYPT-Local	OSCE/OSPE	Research	DO PS	Logbook	Volunteering	Other	minicertex	Evaluation - ITERS
Interventional	F1	√		√	√			√	√	√				√

Neurora diology	F2			√	√		√	√	√	√				√
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Description Table of Formative Assessment Tools (F1,F2)

Performance evaluation and requirements	Formative assessment tools	Important details (description & frequency related to the tool/ academic year)
<b>Workplace-based assessment (WBA)</b>	CBD	<ul style="list-style-type: none"> <li>- Trainees are required to do a minimum of 10 CBD/rotation in the F1 level and a minimum of 20 CBD/rotation in the F2 level.</li> <li>- Total of 100 per academic year in the first year (F1) and total of 200 per academic year in the second year (F2) (Appendix A).</li> <li>- Results are for formative feedback purposes.</li> </ul>
	DOPS	<ul style="list-style-type: none"> <li>- In the first year of the training (F1) the trainee is required to do a minimum of 10 DOPS/rotation in the academic year (Appendix B).</li> <li>- In the second year of the training (F2), the trainee is required to do a minimum of 10 DOPS/rotation in the academic year (Appendix B).</li> <li>- Results are for formative feedback purposes.</li> </ul>
<b>Non-WBA</b> (Each tool needs to be described separately, including details about the level of trainees, frequency, and grading method)	SOE	<ul style="list-style-type: none"> <li>- F1 level trainees must attend 2 SOE session.</li> <li>- The minimum number of SOE station(s): is 3 stations (Appendix C).</li> <li>- The results are used for formative feedback.</li> <li>- The SOE session will be in INR service rotation.</li> </ul>
	OSCE	<ul style="list-style-type: none"> <li>- F2 level trainees must attend 2 OSCE sessions.</li> <li>- The minimum number of OSCE station(s) = 3 stations (Appendix D).</li> <li>- The results are used for formative feedback.</li> <li>- The OSCE session will be in INR service rotation.</li> </ul>
	Educational activity (JC, MD meeting, mini-oral presentation, etc.)	<ul style="list-style-type: none"> <li>- Each trainee level F1 &amp; F2 must do/present at least 3 EA per rotation.</li> <li>- The trainee will be evaluated after each EA session by training supervisor/attending by an evaluation (<b>Appendix E &amp; F</b>).</li> </ul>

Performance evaluation and requirements	Formative assessment tools	Important details (description & frequency related to the tool/ academic year)
	Research activities	Required activities the trainee must complete: <ul style="list-style-type: none"> <li>- All level trainees' progress will be monitored periodically. Those at the F2 level must complete the manuscript by the end of their research rotation.</li> <li>- See Appendix G for details about the research progress requirements and evaluation form.</li> </ul>
	Logbook**	Assesses the trainee's enrolment and daily activity. Should be inspected every 12 weeks and at the end of rotation. Records the procedures that the F1 & F2 trainees are required to complete (see <b>Appendix H</b> ).
	ITER	ITER are related to the discipline & rotation's objectives and the level of training. ITER report must be completed after repeated observations and feedback of the trainee's performance, within two weeks after the end of each rotation.

Refer to the SCFHS "Formative Assessment Tools List" for the description and conduction instructions of each Tool at [www.scfhs.org.sa](http://www.scfhs.org.sa)

- \*\*Logbook Include all the cases that the fellow assist and did not limit to are the following
- Diagnostic angiography (carotid, cerebral, vertebral, spinal)
- Angioplasty and stenting (carotid, cerebral, vertebral, spinal)
- Stroke management (Acute stroke treatment)
- Cerebral aneurysm embolization
- Bran arteriovenous malformation endovascular embolization
- DAV fistula malformation endovascular embolization
- Percutaneous sclerotherapy

- Spine pain management

## 2.3 Formative assessment evaluation scoring

All formative assessment tools used for formative assessment purposes MUST abide by the **Scoring Categories and Scaling Definitions** in the SCFHS policies. Each component was evaluated based on the following:

- **Doesn't Meet Expectation (<50%):** The trainee consistently struggles to meet basic requirements, and requires significant development and intervention in various aspects of training and patient care. Performance consistently lags behind the expected competency level.
- **Borderline (50-69.99%):** The trainee meets some of the criteria satisfactorily, but there are notable deficiencies in their overall performance that require attention and development. Performance frequently falls below the expected competency level, indicating the need for improvement in some areas.
- **Meets Expectation (>70- 89.99%):** The trainee fulfills their role competently, meets the required criteria effectively, and fulfills their responsibilities. Performance consistently aligns with the expected competency level.
- **Exceeds Expectation (>90%):** The trainee constantly demonstrates exceptional clinical skills, professionalism, and commitment to continuous learning. Their performance significantly exceeds expectations.

To attain the optimum training level outcome, the candidate must complete the compulsory requisition of all selected formative assessment tools.

The following compliance of the FA must be fulfilled:

- A. Workplace-based assessment (WBA) tools: Compliance must be no less than 75% for each repetitive tool. The compliance is calculated using the following equation:

Percentage of compliance with executing a single WBA tool= number of encounters performed by the trainee/total number required for the tool

- B. Educational Activities (Non-WBA assessment)

Educational activities (EA) are part of the trainees' training program, which involves teaching and learning activities to acquire specialty competencies. Examples of contributions to educational activities can be, but are not limited to, presenting in journal clubs, lectures, morbidity and mortality rounds, grand rounds, and research and scholarly activities.

The trainee must demonstrate compliance by completing the necessary WBA and EA on time and in accordance with curriculum requirements. Furthermore, failure to comply will result in disciplinary consequences for the trainee, including repeating the entire academic year or a portion thereof.

The trainee should be promoted from one level to the next if they comply with the following requirements:

C. Achievement of the minimaly required compliance of selected WBA and EA



- D. The annual training evaluation report (AITER) is completed by the Program Director. It incorporates WBA and EA compliance, as well as the comments and feedback collected by concerned educators. Ultimately, recommendations from the Program Director are also included. The program training committee then votes to determine the promotion granted. The two promotional options are:
1. Unconditional promotion to next level
  2. Conditional promotion to next level with remediation during the promoted year

## 3. Summative Assessment

### 3.1 General Principles

*Summative* assessment is a component of an assessment that primarily aims to make informed decisions about trainees' competency. Unlike formative assessment, *summative assessment* does not aim to provide constructive feedback. For further details, please refer to the general bylaws and executive policy of assessment (available online at [www.scfhs.org](http://www.scfhs.org)). In order to be eligible to set for the final exams, trainees will be granted "Certification of Training Completion" upon successful completion of all training rotations.

### 3.2. Final In-training Evaluation Report (FITER)

This report will be the basis for obtaining a Certificate of Training Program Completion, as well as the qualification to sit for the final specialty examinations.

In addition to other requirements for the completion of training and registration for the final board examination by the supervisory training committee, the Program Director prepared a final training evaluation report (FITER) for each trainee during the final training year.

Furthermore, a recommendation by the program training committee should be issued based on the FITER report for the last month of the final training year, offering one of the following options:

1. Approved and finished the training requirement.
2. Partially approved and completed the training requirements after successful completion of no more than three months of remediation.
3. Unapproved and incomplete training requirements with an extra training year as remediation required.

### 3.3 Certification of Training-Completion

To be eligible to sit the final INR subspecialty examinations, each trainee is required to obtain the “*Certification of Training-Completion*”. Based on the training bylaws and executive policy (please refer to [www.scfhs.org](http://www.scfhs.org)) trainees will be granted the “*Certification of Training-Completion*” once the following criteria is fulfilled:

- a) Successful completion of all training rotations.
- b) Completion of training requirements (e.g., logbook, research, and others) as outlined in FITER, as approved by the Scientific Council/Committee of Specialties.
- c) Clearance from SCFHS training ensures compliance with tuition payments and the completion of universal topics.
- d) Passing the first part of the examination (whenever is applicable)

The “*Certification of Training-Completion*” will be issued and approved by the supervisory committee or its equivalent according to SCFHS policies.

### 3.4 Final Specialty Examinations

The final specialty examination is the summative assessment component that grants trainees certification of the specialty. It has two elements:

- a) Final written exam: to be eligible for this exam, trainees are required to have successfully obtained the “*Certification of Training-Completion*.”
- b) Final clinical/practical exam: Trainees are required to pass the final written exam to be eligible for the final clinical/practical exam.

Blueprint Outlines: The content of the following table is for demonstration only (please refer to the most updated version published on the SCFHS website). The blueprint of the final written, clinical, and practical examinations are shown in the following table.

[Example of written and oral exam blueprint](#)





## Contents

Category	Management strategies	Diagnostic options	Clinical Approaches	Procedural Techniques	Pre- and postoperative procedures	Follow up
<b>Aneurysms</b>	10	2	2	3	2	1
<b>Stroke</b>	10	2	2	3	2	1
<b>Brain AVMs</b>	10	2	2	3	2	1
<b>Spinal AVMs</b>	10	2	2	3	2	
<b>Brain, head and neck tumor embolization</b>	10	2	2	3	2	1
<b>Spinal procedures</b>	10	2	2	3	2	1
<b>Dural AVF</b>	10	2	2	3	2	1
<b>Others percutaneous neural procedures</b>	10	2	2	3	2	1
<b>Diagnostic angiograms</b>	10	2	2	3	2	1

## Contents

Category	Management strategies	Diagnostic options	Clinical Approaches	Procedural Techniques	Pre- and postoperative procedures	Follow up
<b>Scholarly activities and others 10%</b> (research, ethics, professionalism, and patient safety)	10					
<b>Total</b>	100%					

For further details of the final examinations, please refer to the general bylaws and executive policy of the assessment (available online: [www.scfhs.org](http://www.scfhs.org))



Learning domain	Summative assessment tool	Passing score
Knowledge	Final Written Examination	At least borderline pass in each tool in accordance with the standard setting method used by the executive administration of assessment
Skills	Objective structured clinical examinations (OSCE) Structured oral examinations (SOE)	At least borderline pass in each tool in accordance with the standard setting method used by the executive administration of assessment
Attitude	- FITER: in-training evaluation report	Successfully pass FITER

## SUGGESTED LEARNING RESOURCES

This list is intended as a study aid. The SCFHS does not intend the list to be regarded as endorsement of these specific references, nor are the exam questions necessarily based solely on these sources.

### Textbooks

Fellows are expected to read comprehensively during all INR rotations.

The following represents a list of suggested textbooks. Neuropathology, neurosurgery and neurology textbooks are also extremely valuable for learning in neurovascular pathology.

Examples of useful neuroradiology textbooks include:

### Case-based textbooks

- Case-Based Interventional Neuroradiology. Timo Krings, Sasikhan Geibprasert, and Karel Gter Brugge.

- Neurovascular Anatomy In Interventional Neuroradiology. Case-Based Approach. Timo Krings, Sasikhan Geibprasert, Juan Pablo Cruz, and Karel G. Ter Brugge.
- Tutorials In Endovascular Neurosurgery And Interventional Neuroradiology. James Vincent Byrne.
- Imaging In Neurovascular Disease, A Case-Based Approach. Waleed Brinjikji, Timo Krings

### Technique-based textbooks

- Handbook Of Cerebrovascular Disease And Neurointerventional Technique. Mark R. Harrigan and John P. Deveikis.
- Practical Neuroangiography. Pearse Morris.
- Atlas Of Image-Guided Spinal Procedures. Michael B. Furman.

### Web resources and journals

- Neuroangio. <https://neuroangio.org/>
- Interventional Neuroradiology (INR). <https://journals.sagepub.com/home/INE>
- Journal of Neurointerventional Surgery. <https://jniss.bmj.com/>
- American Stroke Association. <https://www.ahajournals.org/journal/str>



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## XII. PROGRAM AND COURSES EVALUATION

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The SCFHS applies variable measures to evaluate training implementation. The training outcomes of this program will follow the quality assurance framework endorsed by the Central Training Committee of the SCFHS. Trainees' assessment (both formative and summative) results will be analyzed and mapped to the curriculum content. Other indicators that will be incorporated are as follows:

- Report of the annual trainees' satisfaction survey.
- Reports from trainees' evaluation of faculty members.
- Reports from trainees' evaluation of rotations.
- Reports from the annual survey of Program Directors.
- Data available from program accreditations.
- Reports from direct field communications with trainees and trainers.

Goal-based evaluation: The intended achievement of milestones will be evaluated at the end of each stage to assess the progress of curriculum delivery, and any deficiency will be addressed in the following stage, utilizing the time devoted to trainee-selected topics and professional sessions.

In addition to subject-matter opinions and best practices from benchmarked international programs, the SCFHS will apply a robust method to ensure that this curriculum will utilize all the data available during its revision in the future.

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## XIII. POLICIES AND PROCEDURES

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This curriculum represents the means and materials that outline the learning objectives with which trainees and trainers interact to achieve 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 training-related processes. The 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 implemented. Under this curriculum, trainees, trainers, and supervisors must comply with the most updated bylaws and policies, which can be accessed online (via the official SCFHS website).



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# XIV. APPENDICES

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Appendix A. Specifications For The Case Based Discussion (CBD)

Appendix B. Skills Should Be Observed In The Direct Observation Of Procedural Skills (DOPS)

Appendix C. Structured Oral Examination (SOE)

Appendix D. Objective Structured Clinical Examinations (OSCE)

Appendix E. Mini-Oral Presentation Evaluation Form.

Appendix F. Journal Club Evaluation Form.

Appendix G. Research Evaluation Form

Appendix H, Procedure Logbook

## Appendix A

### Specifications for Case-based Discussion

	Discussion specifications
Pre-procedural requirements.	<ul style="list-style-type: none"><li>- Be familiar with available imaging, discuss any required new imaging studies including noninvasive and invasive techniques <b>(Essential for the F1 level)</b>.</li><li>- Provide adequately detailed and relevant clinical history, and treatment indications <b>(Important for both levels)</b>.</li><li>- Recognize available management options for the specific patient condition in detail and outline the advantages and disadvantages of each one <b>(Essential for the F1 level)</b>.</li><li>- Demonstrate enhanced decision-making regarding the final management plan <b>(Essential for the F2 level)</b>.</li><li>- Liaison with the primary referring teams.</li><li>- Improve communication skills including the delivery of news to the patient and their family in the appropriate way, with consideration for any intellectual, socioeconomic and educational diversity <b>(Important for both levels, and should be emphasized in F1 level)</b>.</li><li>- Discuss the management options to the patient/next of kin and explain the consensus recommendations <b>(Important for both levels, and should be emphasized in F1 level)</b>.</li><li>- Obtain informed consent for a specific procedure, explaining the risks, benefits, and alternative options to the patient and their family. <b>(Essential for both levels)</b>.</li><li>- Discussion the primary and secondary plans with the primary attending <b>(Essential for the F2 level)</b></li></ul>





	Discussion specifications
Procedural utility tools	<ul style="list-style-type: none"> <li>- Be familiar with the equipment required for a specific procedure <b>(Essential for the F1 level)</b>.</li> <li>- Decide on the items needed for a specific procedure after discussing the primary attending/supervisor <b>(Important for both levels but should be emphasized in the F2 level)</b>.</li> <li>- Know and memorize the compatibility of each item with other items and vice versa, prioritizing the sustainable use of resources <b>(Essential for the F2 level)</b>.</li> <li>- Commitment to the primary plan and identify the limitations including trainee’s skills, and the preferred decision (to perform the procedure or not). <b>(Essential for the F1 level)</b>.</li> <li>- Identify the most appropriate timepoint for switching plans or aborting the procedure <b>(Essential for the F2 level)</b>.</li> </ul>
Post-procedural assessment	<ul style="list-style-type: none"> <li>- Provide an appropriate procedure summary <b>(Essential for the F1 level)</b></li> <li>- Decide if the procedure is a success or a failure <b>(Essential for the F1 level)</b></li> <li>- Discuss the post-procedural plan and recommendations including required imaging, drugs, required follow up and the level of required care (i.e., NICU, high dependency uni- or routine care) <b>(Important for both levels but should be emphasized in F2 level)</b>.</li> <li>- Deliver these consensus conclusion/results and future plan to the patient and/or the family as appropriate <b>(Important for both levels but should be emphasized in F1 level)</b>.</li> </ul>

## Appendix B

Skills should be observed in the Direct Observation of Procedural Skills (DOPS)

Procedure	Skills observed
Procedural/room preparation <b>[F1 level must master these skills]</b>	<ul style="list-style-type: none"> <li>- Be familiar with the equipment required for the procedure.</li> <li>- Prepare the flush lines and select the catheters and wires required.</li> <li>- Ensure sterility during the procedure.</li> <li>- Know the expectations placed on the trainee during the procedure (e.g., as the primary operator, secondary operator, or assistant).</li> <li>- Communicate professionally with the nursing staff and technicians.</li> </ul>
Arterial access (the common femoral artery and radial artery) <b>[F1 level must master these skills]</b>	<ul style="list-style-type: none"> <li>- Adequate use of ultrasound to identify the puncture site.</li> <li>- Be able to visualize/localize needle tip under ultrasound guidance.</li> <li>- Perform arterial puncture using the single-wall puncture.</li> <li>- Perform arterial access with palpation alone in the absence of ultrasound.</li> <li>- Safe placement</li> </ul>
Venous access (the common femoral vein and arm veins) <b>[F1 level must master the skills in that manner]</b>	<ul style="list-style-type: none"> <li>- Adequate use of ultrasound to identify the puncture site.</li> <li>- Be able to visualize/localize needle tip under ultrasound guidance.</li> <li>- Perform venous puncture using the single-wall puncture and aspiration technique.</li> </ul>
Diagnostic cerebral angiogram <b>[F1 level must</b>	<ul style="list-style-type: none"> <li>- Manipulate the catheter and wires under fluoroscopy guidance up to the aortic arch.</li> </ul>



Procedure	Skills observed	
<b>master the skills in that manner]</b>	<ul style="list-style-type: none"> <li>- Access into the major aortic branches.</li> <li>- Selective access into cervical arteries.</li> <li>- Able to use reverse angle catheters and how to shape them.</li> <li>- Select adequate projections for the angiogram.</li> <li>- Perform hand and power injector runs.</li> <li>- Perform 3D rotational angiogram.</li> <li>- Identify pathology and decide if any further views are required for further evaluation.</li> <li>- Diagnose effectively and communicate the diagnosis professionally with the treating teams.</li> <li>- Advice on further imaging requirements or the management of the pathology.</li> </ul>	
Diagnostic spinal angiogram <b>[F1 level must master the skills in that manner]</b>	<ul style="list-style-type: none"> <li>- Manipulate the catheter and wires under fluoroscopy guidance up to the aortic arch.</li> <li>- Access the intercostal and lumbar arteries.</li> <li>- Use reverse angle catheters and know how to shape them.</li> <li>- Select adequate projections for the angiogram.</li> <li>- Perform hand and power injector runs.</li> <li>- Perform 3D rotational angiogram.</li> <li>- Identify pathology and decide if any further views are required for further evaluation.</li> <li>- Diagnose effectively and communicate the diagnosis professionally with the treating teams.</li> <li>- Advice on further imaging requirements or the management of the pathology.</li> </ul>	
<b>The therapeutic intervention procedures</b>	<b>Skills that should be observed/assessed at the F1 Level</b>	<b>Skills that should be observed/assessed at the F2 Level</b>
Acute stroke management / mechanical thrombectomy procedure	<ul style="list-style-type: none"> <li>- Assess code stroke imaging.</li> <li>- Appropriate patient selection based on current guidelines.</li> </ul>	<ul style="list-style-type: none"> <li>- Manipulate microcatheters and microwires into intracranial vasculatures.</li> <li>- Be familiar with various mechanical</li> </ul>

Procedure	Skills observed	
	<ul style="list-style-type: none"> <li>- Liaise with the interventional and anesthetic teams.</li> <li>- Be familiar with mechanical thrombectomy and tailor the procedure for each individual case.</li> <li>- Access the cervical and intracranial arteries.</li> </ul>	<ul style="list-style-type: none"> <li>thrombectomy procedures including aspiration alone, SOLUMBRA, etc.</li> <li>- Identify underlying atherosclerotic disease with appropriate management including balloon angioplasty or stenting.</li> <li>- Identify distal emboli and determine the TICI score at conclusion of procedure.</li> <li>- Identify any immediate intra-operative complications.</li> </ul>
Intracranial aneurysm treatment	<ul style="list-style-type: none"> <li>- Able to diagnose on non-invasive imaging, including CTA and MRA.</li> <li>- Familiarity with various treatment options for narrow and wide neck aneurysms.</li> <li>- Be able to manipulate microwire and microcatheter into the aneurysm.</li> </ul>	<ul style="list-style-type: none"> <li>- Navigate to the aneurysm and access the dome with the coiling microcatheter and identify the different techniques to achieve the goal of the procedure (be able to secure the ruptured point if the case is ruptured, obliterate the aneurysm or parent vessel reconstruction by placing a flow diverter stent).</li> <li>- Identify procedural complications and be able to manage the complications.</li> </ul>



Procedure	Skills observed	
		<ul style="list-style-type: none"> <li>- Be familiar with alternative management options including open vascular surgery.</li> </ul>
<p>Intracranial-extracranial embolization procedures including AVM, dural fistulas, tumor embolization, and middle meningeal artery embolization</p>	<ul style="list-style-type: none"> <li>- Be familiar with various liquid embolic agents including advantage and disadvantage of each embolic agent.</li> <li>- Be familiar with the different items and techniques used in the treatment.</li> </ul>	<ul style="list-style-type: none"> <li>- Obtain a good and stable construct for the system used in the embolization.</li> <li>- Navigate to the distal targeted feeder supplying the high flow shunt and perform selective microrun via the microcatheter.</li> <li>- Recognize whether it is safe to proceed in embolization after the microrun.</li> <li>- Identify procedural complications and be able to manage the complications.</li> </ul>
<p>Percutaneous sclerotherapy</p>	<ul style="list-style-type: none"> <li>- Identify and characterize the lesion on cross-sectional imaging.</li> <li>- Be familiar with various sclerotherapy agents.</li> <li>- Access the lesion under ultrasound guidance.</li> <li>- Identify procedural complications.</li> </ul>	

## Appendix C

### Structured Oral Examination (SOE)

SOE will be the primary assessment tool for the F1-level fellows.

- It will be conducted twice, at six months and 12 months of the fellowship.
- There will be a minimum of 3 stations during each SOE.
- Each station will be based on a mock clinical scenario.
- Two examiners will be involved in each SOE.
- The fellows will be assessed using a set format (Form 1)
- Feedback will be provided to each fellow at the conclusion of the SOE.

### Evaluation form for the SOE

#### Case history:

Include detailed description of the demographics, clinical symptoms and available laboratory findings.

#### Imaging:

Any related imaging will be provided to the fellow.



## Assessment:

	Meets expectation	Borderline	Does not meet expectation	Exceed expectation	Remarks
Diagnosis of vascular pathology on imaging					
Pre-operative management					
Operative management: <ul style="list-style-type: none"> <li>• Informed consent (risks, benefits, alternatives)</li> <li>• Techniques for endovascular management options</li> <li>• Equipment required</li> <li>• Potential complications</li> <li>• Management of complications.</li> </ul>					
Post-operative management					
Alternative management options					

## Appendix D

### Objective Structured Clinical Examinations (OSCE)

- OSCE will be utilized for evaluation of the F2-level fellows.
- It will be conducted twice, in the 26th and 50th weeks of the second year.
- There will be a minimum of three stations during each OSCE, which will be based on brief clinical cases with imaging: noninvasive (e.g., CT, MRI, and CTA) and invasive (e.g., DSA).
- The exam will be computer-based, without involvement of any examiners.
- Fellows will be assessed based on the diagnosis, and pre-procedural, procedural, and post procedural management.
- Feedback will be provided to each fellow at the conclusion of the OSCE.

### Evaluation form for the OSCE

#### Case history:

Descriptions of the demographics, clinical symptoms, and available laboratory findings will be provided for each clinical case.

#### Imaging:

Any related imaging will be provided to the fellow.





Assessment:


	Meets expectation	Borderline	Does not meet expectation	Exceed expectation	Remarks
Diagnosis of vascular pathology on imaging					
Any additional diagnostic tools or measures to be requested?					
Management options for such pathology (Complete management plan)					
Specific Post-operative Care? If there is any					
Possible complications and management of them					

Does not meet expectation	Borderline	Meets expectation	Exceeds expectation
(<50%)	(50-69.99%)	(>70- 89.99%)	(>90%)



## Appendix E


### Mini-oral presentation evaluation form

<div style="text-align: right;">                        الهيئة السعودية للتخصصات الصحية                      Saudi Commission for Health Specialties                 </div>			
<b>INTERVENTIONAL NEURORADIOLOGY SAUDI FELLOWSHIP                      JOURNAL CLUB EVALUATION FORM</b>			
Fellow Name:		Level: F1 <input type="checkbox"/> F2 <input type="checkbox"/>	
Name of Article:			
-Describe the most positive aspect of the resident's presentation:			
-Describe areas for further improvement:			
No.	Component	Marks	Candidate Score
<b>Part-1 Interpersonal &amp; communication skills</b>	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	
<b>Part-2 Medical knowledge</b>	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	
<b>Part-3 Slides &amp; visual aids</b>	The slides were clear and well organized.	5	
	Number and clarity of slides	5	
	Uses of figures, tables, etc. effectively	5	
<b>TOTAL SCORE</b>		<b>100</b>	
<b>Doesn't Meet Expectation (&lt;50%)</b>		<b>Exceeds Expectation (&gt;90%)</b>	
<b>Borderline (50-69.99%)</b>		<b>Meets Expectation (&gt;70- 89.99%)</b>	



## Appendix F


### Journal club evaluation form

 الهيئة السعودية للتخصصات الصحية Saudi Commission for Health Specialties			
INTERVENTIONAL NEURORADIOLOGY SAUDI FELLOWSHIP JOURNAL CLUB EVALUATION FORM			
Fellow Name:		Level: F1 <input type="checkbox"/> F2 <input type="checkbox"/>	
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	
Part-3 Slides & visual aids	Presented an accurate summary and recommendation/s.	10	
	The slides were clear and well organized.	5	
	Number and clarity of slides	5	
	Uses of figures, tables, etc. effectively	5	
TOTAL SCORE		100	
Doesn't Meet Expectation (<50%)	Borderline (50-69.99%)	Meets Expectation (>70- 89.99%)	Exceeds Expectation (>90%)
NAME OF EVALUATOR: _____ SIGNATURE: _____ DATE: _____			

Does not meet expectation	Borderline	Meets expectation	Exceeds expectation
(<50%)	(50-69.99%)	(>70- 89.99%)	(>90%)

## Appendix G

### Research evaluation form

<div style="text-align: right;">                     الهيئة السعودية للتخصصات الصحية                      Saudi Commission for Health Specialties                 </div> 				
<b>INTERVENTIONAL NEURORADIOLOGY SAUDI FELLOWSHIP                      RESEARCH PRESENTATION EVALUATION FORM</b>				
Fellow Name:		Trainee SCFHS number:		
RESEARCH TITLE:				
No.	Component	Marks	Candidate Score	Comment
<b>Part-1</b> 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		
<i>Total Written Evaluation</i>		<b>60</b>		
<b>Part-2</b> Defense	1. Presentation	30		
	2. Defense	10		
	Total Defense Evaluation	40		
<i>Total Cumulative Marks</i>		<b>100</b>		
Comments:				
Name Of Evaluator: _____ Signature: _____ date: _____				
Doesn't Meet Expectation (<50%)	Borderline (50-69.99%)	Meets Expectation (>70- 89.99%)	Exceeds Expectation (>90%)	

## 2.2.6 RESEARCH ROTATION

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

### MEDICAL EXPERT

#### Goals:

- To demonstrate the basic principles of research design, methodology, data analysis, and clinical epidemiology. In addition, they have both advantages and disadvantages from the perspective of radiology.
- Familiarize themselves with the ethical requirements of the research and demonstrate an understanding of the responsible use of informed consent.
- To understand and practice appropriate methods for writing the research manuscript, data collection, and results analysis and discussion.
- To demonstrate the awareness of current research topics in radiology using available medical informatics systems.
- To acquire the skills for scientific presentations and public discussions.

#### Training Methods

- A dedicated 4-weeks, full-time rotation in research is conducted.
- This project is expected to last more than a month. Therefore, the completion of this work should be parallel to subsequent rotations.
- The fellow must choose a supervisor to help access the essential resources that allow an appropriate understanding of research skills and periodically discuss progress.
- Attendance in dedicated courses or workshops that enhance research skills may be required for the program.
- The fellow must finish the research proposal by the end of the first 6 months and should be accepted by the Neuroradiology Research Committee.
- The oral abstract of the study results should be presented in the second year of the Fellow Neuroradiology Research Day.

- The research paper should be sent at least two weeks before the Neuroradiology Research Day.
- It is highly desirable for fellows to present their research results at national and/or international meetings and work hard to publish their work in indexed journals.

### Evaluation

- Attendance at designated courses/lectures was monitored and incorporated into the annual evaluation scores.
- Panel scoring of the research abstract presentation will be conducted at the end of the 2nd year, on the Neuroradiology Research Day. This was considered as the rotation score for that month.

### COMMUNICATOR

- Demonstrate skills in conveying and discussing scientific research to scientific communities through posters, abstracts, teaching slides, manuscripts, and other scientific communications.
- Communicate and collaborate effectively with research supervisor to conduct the research.

### COLLABORATOR

- Identify, consult and collaborate with appropriate experts to conduct the research.

### LEADER

- Demonstrate the ability to identify an area of research interest and engage as a research supervisor in scholarship on scientific inquiry and dissemination.
- Demonstrate the ability to utilize available resources and regularly meet an identified research mentor.
- Demonstrates the ability to set realistic priorities and use time effectively to optimize professional performance.
- Demonstrate an understanding of the cost-effective use of health care resources.

### HEALTH ADVOCATE

- Recognize the contributions of scientific research in improving 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 the question, and formulate an appropriate study design to answer it.
- Demonstrate ability to carry out the research outlined in the proposal.
- Demonstrate the ability to collect and analyze data, and prepare an abstract and manuscript.
- Demonstrate ability to identify areas for further research.

## PROFESSIONAL

- Ethical and professional research expectations were consistent with the institutional review board guidelines, including the maintenance of meticulous data and the conduct of ethical research.
- Demonstrates personal responsibility for setting research goals and working with supervisors to set and achieve research timeline objectives.
- Publish accurate and reliable research results, with attention to appropriate authorship attribution criteria.
- Disclose potential financial conflicts of interest (including speaker fees and consultative relationships) when engaging in and disseminating research results.





## Appendix H

Procedure Logbook [The trainee will be provided with an Excel file ready to be filled that specifies the procedure name from a drop menu, as shown in the example below]:

	A	B	C	D	E	F	G	H
1		NB use the dropdown to enter Procedure type			FELLOWS INITIALS			
2	<b>Interventional Neuroradiology Fellowship Logbook</b>							
3		Procedure date	Age	MRN	Procedure	Primary Operator	Secondary Operator	Attending
4	1							
5	2				Aneurysm - coil			
6	3				Aneurysm - coil - balloon remodelling			
7	4				Aneurysm - coil - stent assist			
8	5				Aneurysm - intrasaccular flow disruptor			
9	6				Aneurysm - flow diverter +/- coils			
10	7				Aneurysm - vessel sacrifice			
11	8				Aneurysm - inaccessible			
12	9				Aneurysm - other (please specify)			
13	10				Vasospasm - IA chemical infusion (below skull base)			
14	11				Vasospasm - IA chemical infusion (intracranial)			
15	12				Vasospasm - balloon angioplasty			
16	13				Vasospasm - IA chem/angioplasty			
17	14							
18	15							
19	16							
20	17							
21	18							

## Year F1:

- In the first year of training, the fellows are primarily involved in diagnostic angiography. After the initial six months of training and based on the individual capabilities of the fellows, they will be exposed to interventional procedures starting with the endovascular management of acute ischemic stroke. As fellows progress in training, they will be exposed to the management of complex cerebrovascular diseases. By the end of the first-year fellowship, the fellows are expected to perform diagnostic cerebral and spinal angiograms via femoral and radial access. Fellows are expected to become the primary operators during the endovascular management of most acute ischemic stroke cases as they transition to the second year of training.

## Year F2:

- Second-year fellows will be considered senior fellows and expected to assist junior fellows in diagnostic angiography. They will be primarily involved in therapeutic interventions. As training progresses and based on individual capabilities, second-year fellows are expected to become the primary operators in most interventional cases.

## References:

1. Song Y, Kim M, Söderman M, Suh DC, Berg RVD. International Survey on Criteria for Training and Accreditation in Interventional Neuroradiology; Neurointervention. 2020 Jul;15(2):55-59. doi: 10.5469/neuroint.2019.00283. Epub 2020 Apr 9. PMID: 32268721
2. Sasiadek M, Kocer N, Szikora I, et al. Standards for European training requirements in interventional neuroradiology guidelines by the Division of Neuroradiology/Section of Radiology European Union of Medical Specialists (UEMS), in cooperation with the Division of Interventional Radiology/UEMS, the European Society of Neuroradiology (ESNR), and the European Society of Minimally Invasive Neurological Therapy (ESMINT). J Neurointerv Surg. 2020;12:326–31.

