

# Standards of practice in interventional neuroradiology

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**Abstract** The growing importance of INR has resulted in the need to define and promote professional standards of clinical practice. Several professional organizations have published guidelines recently for the neurointerventional treatment of cerebrovascular diseases, including technical and personal recommendations, but detailed definitions of technical and organizational conditions needed for the safe and effective performance of such treatments are lacking. To fill this gap ESNR, ESMINT and the UEMS Division for Neuroradiology established a working group, to develop a consensus paper on “Standards of Practice in Interventional Neuroradiology”. This document is the result of the Consensus Working Group and has following review gained approval by the Executive Boards of ESNR and ESMINT and by the members of the UEMS Division for Neuroradiology in 2017.

**Keywords** Interventional neuroradiology guideline

## Introduction

In recent years, interventional neuroradiology (INR) has increasingly become a central and integral part of the treatment

of patients with ischemic and haemorrhagic stroke. Subsequently, with the plethora of clinical evidence demonstrating a significant improvement in patient outcomes, INR has evolved from a niche field to a major element in the management of cerebrovascular diseases in everyday practice.

This growing importance of INR has resulted in the need to define and promote professional standards of clinical practice. The role of these standards is to guide and assist with the development of safe staffing practices, appropriate delegation of tasks to personnel, as well as the overall management of the INR team and healthcare organization infrastructure. The scientific acceptance of endovascular therapy is rooted in studies that were primarily performed in established INR departments implementing evidence-based standards [1–6].

INR is a highly specialized discipline which necessitates combining manual dexterity and skill with a high level of scientific and clinical knowledge of neuroradiology and neurosciences. Evidence shows that INR treatment provides the best possible outcome technically and clinically for the patient when certain conditions and criteria are available and fulfilled. Thus, professional standards guarantee that we are accountable for our clinical decisions and actions, and for maintaining competence during our career; they also provide an evaluation tool for clinicians and the INR team to ensure clinical proficiency and safety.

Recently, multiple professional organizations have published guidelines for neurointerventional treatment of cerebrovascular diseases, including technical and personal recommendations which are required to carry out endovascular therapies [7–9]. Yet, detailed definitions of technical and organizational conditions required for the safe and effective performance of such treatments remain undefined. In 2015, ESNR, ESMINT and the UEMS Division for Neuroradiology decided to establish a working group to work collectively and synergistically to develop a consensus paper on “Standards of

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Practice in Interventional Neuroradiology”. The final document is the result of multiple fruitful interactions and contributions from all members of the Consensus Working Group and has, following review, been approved by the Executive Boards of ESNR and ESMINT as well as by the members of the UEMS Division for Neuroradiology in 2017.

As with all consensus papers, the results reflect a compromise of opinions and are therefore meant to act primarily as a guide to clinical practice. It is intended to be utilized as a basis for standards of neurointerventional practice and as a recommendation by the authors and the involved organizations from which individual national guidelines can be developed and adapted. The further endorsement of this consensus paper by other scientific organizations will be very much appreciated.

## Purpose

This is a consensus document, which provides recommendations based on expert opinions and best available evidence, in relation to the optimal conditions for the safe practice of interventional neuroradiology.

### Art. 1

Interventional neuroradiology involves percutaneous and endovascular procedures to treat disorders of the brain, sensory organs, head, neck, spinal cord, vertebral column, adjacent structures and the peripheral nervous system in adults and children.

Commonly utilized interventional neuroradiology techniques include:

- Embolization
- Angioplasty
- Devices implantation (stents, coils, etc.)
- Thrombectomy
- Percutaneous spinal/head and neck procedures
- Image-guided administration of drugs

## Site conditions

### Art. 2

The practice of interventional neuroradiology should only take place in healthcare institutions that routinely provide services and treatments to patients with neurological and other disorders (as defined in Art. 1).

Required on-site facilities that must be available on site include:

- Inpatient hospital wards/beds
- A suitable (see Art. 3) interventional angiography suite(s), which is part of a Radiology/Neuroradiology/Neurointerventional Department
- A team of trained interventional neuroradiologists/neurointerventionists which is part of a Radiology/Neuroradiology/Neuro-interventional Department
- A dedicated and comprehensive Diagnostic Neuroradiology Department/Section that comprises state-of-the-art CT and MRI facilities
- A department of Neurosurgery and Neurology Department with neurovascular expertise
- Intensive Care Unit

### Art. 3

A suitable interventional angiographic suite implies the ability to routinely accommodate general anaesthesia under aseptic conditions similar to an operating theatre.

Optimally, procedures should be carried under the image guidance of a bi-plane digital angiography unit with three-dimensional image reconstruction including flat panel-CT capabilities.

At a minimum, each suite should comprise of a single plane high resolution C-arm with digital subtraction. 3D imaging should be available in all diagnostic modalities, i.e., CT, MRI, catheter angiography, etc.

National and European Radiation protection regulation measures in accordance with the national and European regulations should be in place with designated individuals responsible for carrying out the necessary checks and audits.

### Art. 4

A suitable interventional neuroradiology facility (as defined in Art. 3) should be able to provide the services defined in Art. 1, on a full-time basis, 24/7, all year around (as a single institution or organized in a network of centres).

### Art. 5

There needs to be a minimum workload for individual operators and the institution overall must be met (for individual operators and the institution overall) in order for a centre to be recognized in the practice of interventional neuroradiology. These numbers should follow the local/national neuroradiology/neurointerventional recommendations and should be consistent with quality assurance guidelines.

**Art. 6**

Interventional neuroradiology should ideally be practiced in neurointerventional teams in which exchange of experience, knowledge and research is possible and encouraged. A suitably trained clinician should be able to perform procedures as defined in Art. 1, with the support of other interventional neuroradiologists. The solitary practice of interventional neuroradiology is strongly discouraged.

**Operational guidelines****Art. 7**

It is recommended that interventional neuroradiologists/neurointerventionists carry holdout outpatient clinics and have admitting privileges either in units/beds dedicated to interventional neuroradiology or in other appropriate inpatient facilities.

A sufficient number of these inpatient beds (intensive care or continually monitored beds) should be available, to accommodate interventional neuroradiology patients at any time.

The interventional neuroradiologist/neurointerventionist should share responsibility for pre- and post-operative patient care with the appropriate specialities. This should include pre-operative examination and consultation, documented informed consent, operative and post-operative management as well as follow-up consultation in outpatients.

**Art. 8**

In order to provide a comprehensive service as defined in Art. 1, the following overall medical staff should be available to carry it out:

- A minimum of two, and for an optimal service at least four, physicians with particular training and qualification in interventional neuroradiology
- Anaesthetists with experience in caring for patients undergoing interventional neuroradiology procedures

**Art. 9**

With regard to individual procedures, it is recommended that the following staff are present for each case:

- A lead interventional neuroradiologist/neurointerventionist

- A second scrubbed individual (i.e., supporting interventional neuroradiologist/neurointerventionist, scrub nurse or radiographer)
- A radiographer
- A nurse or nurse assistant
- An anaesthetist, if required, according to local regulations

**Compliance with ethical standards**

**Conflict of interest** The authors declare that they have no conflict of interest.

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