



**Curriculum for
Undergraduate
Radiological
Education**

U-Level Curriculum

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Coordination: ESR Office, Am Gestade 1, 1010 Vienna, Austria
 Phone: +43 1 533 40 64-28 | Fax: +43 1 533 40 64-448
 E-mail: boardaffairs@myesr.org | www.myESR.org
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PREFACE

The Curriculum for Undergraduate Radiological Education (U-Level Curriculum) is meant to provide radiologists involved in curricular planning in medical schools throughout Europe with potential content. The role and extent of radiology within undergraduate medical education varies widely between medical schools and countries. The year when radiological content is provided varies also between medical schools in different countries and sometimes even within the same country.

The current U-Level Curriculum is by no means meant as a ubiquitous requirement, but rather as a basis to work on in curricular planning, depending on the individual situation in the respective medical faculty. Parts of the curricular contents of this curriculum may seem too advanced for some situations in undergraduate medical education; these can be reserved for medical students with a special interest in radiology e.g., those performing electives in radiology.

The U-Level Curriculum is divided into two modules. Module U-I covers basic topics in radiation biology, radiation protection and imaging modalities. Module U-II contains the fundamental principles of radiology and image-guided interventions for the most important and/or common diseases and disorders. As with Levels I, II and III of the European Training Curriculum for Radiology, the chapters of the U-Level Curriculum are further subdivided into sections titled Knowledge, Skills, and Competences & Attitudes.

The Curriculum for Undergraduate Radiological Education is intended as a guide to help improve and standardise education in radiology throughout European medical schools.

As the specialty of radiology is evolving continuously, this document is meant as a living document and should be reviewed and revised at regular intervals to adapt its content to the profession's advances.

I would like to sincerely thank the Undergraduate Education Subcommittee and its chairperson Prof. Vicky Goh, my predecessor Prof. Carlo Catalano, the members of the board of the Radiology Trainees Forum, the Board of Directors and the Executive Council of the European Society of Radiology as well as all the office team of the ESR for their immensely valuable support.

Geneva, June 2021

Minerva Becker
Chairperson of the ESR Education Committee

INTRODUCTION

Radiology is a discipline with high relevance during undergraduate medical education. Imaging should already form a part of medical education during preclinical studies (which in some countries is comprised of a bachelor's degree) with cross-sectional and radiographic anatomy, radiation biology, radiation protection and imaging physics. During the clinical part of undergraduate medical education (which in some countries is referred to as a master's degree), radiology is vital to teach the diagnostic work-up as well as image-guided therapeutic approaches for almost all disease entities.

Last but not least, radiology and medical imaging are an integral part of most examinations throughout undergraduate medical education including finals.



The curriculum for undergraduate medical education is divided into two modules:

Module U-I:

This module covers the basic principles of radiation biology, radiation protection and imaging physics. Risks, benefits and potential side effects of the different modalities and contrast media are also covered. This module is mostly modality-oriented.

Module U-II:

This module covers the fundamental aspects of radiology and image-guided interventions for the most important and/or most common diseases of the various organ systems including basic principles of interdisciplinary communication. This module is mostly organ system-oriented.

The curriculum is not meant as a ubiquitous requirement or as a checklist for examinations, but rather as a succinct framework to aid radiologists in curricular planning in medical schools; and as a guide for medical students as to the knowledge and skills they should aim to have as a future doctor. The curriculum provides the information of the necessary knowledge and skills medical students should acquire during their training period, to correctly interpret basic radiological exams in the context of the individual patient with understanding of applicability and limitations.

The contents of the curriculum can be integrated flexibly into curricular planning. Module U-I could for example form the basis for a radiological course in the earlier phases of the medical curriculum, while module U-II could be integrated into an organ system-based curriculum, if applicable. In faculties with integrated teaching systems, module U-I should be preferentially taught toward the beginning of medical education, while the chapters in module U-II can be integrated more easily into the remainder of the medical curriculum. Radiation protection may be presented following a holistic concept of safety within this setting. Moreover, radiological teaching of imaging anatomy can be readily integrated into an anatomy lecture module. Overall, radiology should be understood in a broad sense as biomedical imaging and image-guided intervention. Nuclear medicine and aspects of anatomy might be integrated in such a concept depending on the setting in the respective medical faculty.

The referral for medical imaging should be an important starting point for the teaching modules and chapters. The sections in module U-II can be designed as training course in writing referrals for imaging and in becoming familiar with interpreting imaging examinations for common indications and interpreting reported results. Another important aspect to be introduced is the knowledge of the common indications and preparation for imaging studies, as well as the limitations and contraindications, and all aspects of completing request forms correctly. Students should also acquire a basic understanding of the risks of ionising radiation, magnetic resonance and ultrasound imaging, the use of contrast media and the risks associated with different interventional procedures. Students should learn how to communicate effectively with patients, health care professionals and radiological teams as future doctors.

Students should be encouraged to attend radiological investigations, to learn to work with radiological tools (e.g., Picture Archiving and Communication Systems (PACS), Radiological Information Systems (RIS), web PACS), to participate in multidisciplinary meetings and to have the possibility to experience the daily work in a radiology department.

During the course of their medical education, medical students should also become familiar with the basic skills of understanding scientific literature. This could also form part of the radiological curriculum.

U-I & U-II:
**U-LEVEL
TRAINING
(UNDERGRADUATE)**

U-LEVEL TRAINING (UNDERGRADUATE)

The subject content of the curriculum for U-Level Training includes the following elements:

Module U-I

U-I-1 Principles of Radiation Biology and Radiation Protection

U-I-2 Principles of Radiological Techniques

U-I-3 Contrast Media in Radiology

Module U-II

U-II-1 Breast Imaging

U-II-2 Cardiovascular Radiology

U-II-3 Chest Radiology

U-II-4 Gastrointestinal and Abdominal Radiology

U-II-5 Gynaecological and Obstetric Radiology

U-II-6 Head and Neck Imaging

U-II-7 Interventional Radiology

U-II-8 Musculoskeletal Imaging

U-II-9 Neuroradiology

U-II-10 Paediatric Radiology

U-II-11 Urogenital Radiology

MODULE U-I

U-I-1

PRINCIPLES OF RADIATION BIOLOGY AND RADIATION PROTECTION

KNOWLEDGE

- To list the sources and properties of ionising radiation and radioactive decay
- To describe the generation of X-rays and their interaction with matter
- To describe the most important dose measures, including absorbed energy dose (Gy), organ and effective doses (Sv)
- To be familiar with the principles of the dose length product (DLP)
- To explain stochastic, deterministic and teratogenic radiation effects
- To describe the effects of ionising radiation on cells, tissues and organs and to list the mechanisms of repair
- To list types and magnitudes of radiation risk from radiation exposure in medicine and to compare it to radiation exposure from natural sources
- To list concepts of dose measurement and the relevant dose limits
- To understand the As Low As Reasonably Achievable (ALARA) principle and appropriateness in radiology
- To list the factors influencing image quality and dose in diagnostic radiology
- To be familiar with the Euratom directive which includes the obligation of keeping records on radiation dose of radiological exams and the patient's clinical record
- To be familiar with the European Commission Radiation Protection Directives, in particular the guidelines on radiation protection education and training of medical professionals in the EU

SKILLS

- To apply the knowledge of radiation biology and physics to optimally prescribe the most appropriate imaging test
- To use the correct terms to characterise exposure from ionising radiation
- To communicate the radiation risk to the patient at an understandable level

COMPETENCES AND ATTITUDES

- To apply the As Low As Reasonably Achievable (ALARA) principle to the prescription of different radiological methods involving ionising radiation
- To avoid unnecessary radiation exposure by choosing the most appropriate imaging test
- To be able to inform patients, patients' families and staff on radiation-related risks and benefits of a planned procedure

U-I-2 PRINCIPLES OF RADIOLOGICAL TECHNIQUES

KNOWLEDGE

- To explain the concept of pre- and post-test-probabilities of diagnostic tests
- To describe the relative value of a radiographic examination for various organ systems and indications
- To list the components of an X-ray unit and explain the process of X-ray generation
- To describe the principles of fluoroscopy and its common indications
- To list and describe the factors affecting image quality and dose in radiography and fluoroscopy
- To describe the principles of soft tissue radiography in mammography
- To describe the positioning of the patient for common radiographic techniques (e.g. chest X-ray)
- To describe the basic normal anatomy of the various organs on radiographic images
- To explain the concept of spatial, temporal and contrast resolution
- To explain the principle of contrast in the different imaging modalities
- To describe the relative diagnostic value of a computed tomography (CT) examination for the various organ systems and indications
- To explain the physical basis of image formation of computed tomography
- To describe the scale of Hounsfield units (HU) and the principle of window centre and width
- To list normal levels of attenuation (in HU) for various organs and common pathologies (e.g. haemorrhage, calcifications)
- To describe the basic normal anatomy of the various organs on CT
- To explain the relative value of a magnetic resonance imaging (MRI) examination for the various organ systems and indications
- To describe the basic principles of image formation with MRI
- To list the most commonly used pulse sequences in MRI (including T2-weighted sequences, T1-weighted sequences, fat suppressed sequences such as STIR sequences, FLAIR sequences, diffusion-weighted imaging)
- To describe the absolute or relative contraindications against MRI
- To explain the safety issues in the MR environment with regard to patients and staff
- To describe the basic normal anatomy of the various organs on MRI
- To explain the relative value of an ultrasound examination for various organ systems and indications
- To describe the basic principles of image formation with ultrasonography and to list the tissue properties that determine it
- To be aware of the indications and contraindications for contrast-enhanced ultrasonography
- To describe the principles of the Doppler effect
- To describe the basic normal anatomy of the various organs on ultrasonography
- To describe the principles of digital subtraction angiography (DSA)
- To have a basic understanding of the different types and techniques of image-guided interventions
- To describe the basic infrastructure of imaging informatics, including Picture Archiving and Communication Systems (PACS) and Radiological Information Systems (RIS) and applications of Artificial Intelligence and Deep Learning to Radiology
- To explain the relative value of hybrid imaging (positron emission tomography (PET)/CT or PET/MRI) for the various organ systems and indications

SKILLS

- To recognise the technology applied when encountering a radiological image (e.g. chest X-ray, lung CT, etc.)
- To recognise sufficient and insufficient image quality in radiography
- To measure Hounsfield units on CT and recognise the respective tissue/substrate
- To recognise the most commonly used pulse sequences and slice orientations when encountering an MR image (e.g. coronal T2-weighted image etc.)

COMPETENCES AND ATTITUDES

- To be able to delineate basic normal anatomy on radiography, CT, MRI and standard ultrasonography (US) examinations
- To communicate the diagnostic value of the respective imaging modalities to the patient for common indications
- To communicate the procedure of common radiological examinations to the patient
- To communicate the risks and benefits of various common radiological examinations (including radiography, fluoroscopy, CT, MRI and US) to patients and their families
- To be able to make a clinical request for conventional radiographs and to know what essential information is needed for a specific prescription
- To be able to make a clinical request, under supervision, for CT, MRI and US examinations, with or without contrast material
- To be able to correctly estimate one's limitations and to know when to seek help and advice from the supervisors regarding the prescription of the most appropriate radiological procedure

U-1-3 CONTRAST MEDIA IN RADIOLOGY

KNOWLEDGE

- To describe the indications for the use of X-ray contrast media in the study of various organs/organ systems
- To describe the indications for the use of CT contrast media in the study of various organs/ organ systems
- To list typical risks and side effects of commonly used iodinated contrast media (X-ray and CT contrast media)
- To describe the indications for the use of MRI contrast media in the study of various organs/organ systems
- To list typical risks and side effects of commonly used MRI contrast media
- To have a basic understanding of contrast media for ultrasonography
- To have a basic understanding of nephrogenic systemic fibrosis and to list measures to reduce it

SKILLS

- To recognise if a CT or MRI is contrast-enhanced or not
- To recognise the various types of contrast-enhanced fluoroscopic examinations

COMPETENCES AND ATTITUDES

- To be able to discuss with the radiologist whether a contrast medium application is warranted for a given clinical indication
- To be able to communicate the risks and benefits of contrast media application for the most common radiological examinations to patients and their families
- To be able to correctly estimate one's limitations and to know when to seek help and advice from the supervisors regarding the prescription of the most appropriate contrast enhanced radiological procedure

MODULE U-II

U-II-1

BREAST IMAGING

KNOWLEDGE

- To describe the normal anatomy and physiology of the female breast, axilla and associated structures and how they change with age and during pregnancy and the lactation process
- To have a basic understanding of the main radiological techniques used for breast imaging, including mammography, US and MRI, as well as their indications and relative diagnostic value
- To have a basic understanding of the appearance of common benign diseases and of breast cancer on mammography, US and MRI
- To have a basic understanding of the benefits, common indications, contraindications and limitations in breast imaging
- To have a basic understanding of how imaging results influence patient treatment

SKILLS

- To delineate the normal imaging anatomy of the breast across the different imaging modalities
- To be able to recognise basic imaging patterns of benign and malignant disease on imaging examinations of the breast based on their description in the radiologic report

COMPETENCES AND ATTITUDES

- To communicate with patients in order explain the benefits, risk and basic technical aspects of diagnostic imaging of the breast
- To communicate the benefits and risks of mammography screening
- To be able to communicate the results of a breast imaging examination, whenever necessary under supervision, to patients and their families based on the radiologic report by the end of the medical studies
- To be able to correctly prescribe the most appropriate imaging examination depending on the clinical situation by the end of the medical studies

U-II-2 CARDIOVASCULAR RADIOLOGY

KNOWLEDGE

- To describe the normal anatomy and physiology of the heart and vessels and how they change with age
- To have a basic understanding of the main imaging techniques used for cardiovascular imaging (including radiography, US, CT, MRI and DSA) as well as their indications and relative diagnostic value
- To describe the different types of cardiac configuration on chest radiography
- To explain which chambers form the border of the cardiac silhouette on a chest radiograph
- To have a basic understanding of congenital heart disease and the diagnostic features on a chest radiograph
- To differentiate radiological features and causes of cardiac enlargement, including acquired valvular disease and pericardial disease
- To recognise the different types of cardiovascular prosthetic devices and their normal positioning
- To understand the typical imaging features of vascular occlusion, stenosis and thrombosis in central and peripheral vessels on CT and DSA
- To understand the diagnostic evaluation of ischaemic heart disease
- To describe the normal dimensions of the aorta and classify aortic aneurysms and dissections
- To have a basic understanding of the benefits, common indications, contraindications and limitations in cardiovascular imaging
- To have a basic understanding of how imaging results influence patient treatment

SKILLS

- To delineate the basic normal imaging anatomy of the cardiovascular system across the different imaging modalities
- To recognise basic imaging patterns of occlusion, stenosis, thrombosis and aneurysm on Doppler US, contrast enhanced CT and DSA in correlation with the radiologic report

COMPETENCES AND ATTITUDES

- To communicate with patients in order to explain the benefits, risks and basic technical aspects of cardiovascular diagnostic and common interventional procedures
- To be able to communicate the results of cardiovascular imaging examinations, whenever necessary under supervision, to patients and their families based on the radiologic report by the end of the medical studies
- To be able to correctly prescribe the most appropriate imaging examination depending on the clinical situation by the end of the medical studies

U-II-3 CHEST RADIOLOGY

KNOWLEDGE

- To describe the anatomy and physiology of the respiratory system on radiographs and CT
- To have a basic understanding of the main imaging techniques used in thoracic imaging including radiography, CT, US and MRI
- To have an understanding of imaging patterns in chest radiology including consolidation, atelectasis, nodules, effusion, pneumothorax, and hyperinflation
- To describe the chest radiography signs, including air bronchograms, silhouette sign, air crescent sign, deep sulcus sign, batwing sign and reverse batwing sign
- To describe the imaging appearance of monitoring and support devices (“tubes and lines”) including endotracheal tubes, central venous catheters, nasogastric tubes, chest drains and pacemakers as well as foreign bodies
- To describe the typical imaging appearances of pleural effusion on radiographs, US and CT
- To describe the typical imaging appearances of pneumothorax and tension pneumothorax on radiographs and CT
- To describe the typical imaging appearances of pneumonia on radiographs and CT
- To describe the typical imaging appearances of emphysema on radiographs and CT
- To describe the typical imaging appearances of bronchogenic carcinoma and pulmonary metastases on radiographs and CT
- To describe the typical imaging appearances of mediastinal masses on radiographs and CT and to be able to provide a differential diagnosis based on the mediastinal compartment involved
- To describe the typical imaging appearances of pulmonary edema on radiographs and CT
- To describe the typical imaging appearances of pulmonary embolism on CT
- To have an understanding of the clinical work-up of lung nodules
- To have an understanding of the common indications, contraindications and limitations of thoracic imaging, in particular for radiographs
- To understand the differences between high resolution CT of the chest, CT pulmonary angiography and staging CT of chest tumours
- To have a basic understanding of how imaging results influence patient treatment

SKILLS

- To delineate the normal imaging anatomy of the chest across the different imaging modalities
- To recognise basic imaging patterns of benign and malignant diseases of the chest on conventional radiographs
- To recognise the correct or malpositioning of monitoring and support devices (“tubes and lines”) including endotracheal tubes, central venous catheters, nasogastric tubes, chest drains, and cardiac pacemakers
- To recognise radio-opaque foreign bodies on conventional chest X radiographs
- To recognise basic imaging patterns of benign and malignant disease on CT based on their description in the radiologic report

COMPETENCES AND ATTITUDES

- To communicate with patients in order to explain the benefits, risks and basic technical aspects of diagnostic and common interventional imaging procedures of the chest
- To be able to communicate the results of chest imaging examinations, whenever necessary under supervision, to patients and their families based on the radiologic report by the end of the medical studies
- To be able to correctly prescribe the most appropriate imaging examination depending on the clinical situation by the end of the medical studies

U-II-4

GASTROINTESTINAL AND ABDOMINAL RADIOLOGY**KNOWLEDGE**

- To describe the basic normal anatomy and physiology of the solid and hollow abdominal viscera, omentum, mesentery and peritoneum on radiographs, CT, US and MRI
- To have a basic understanding of the main imaging techniques used in gastrointestinal, hepatobiliary and abdominal imaging, including radiography, fluoroscopy, US, CT and MRI
- To understand the typical imaging appearances of acute abdominal conditions, including perforation, haemorrhage, infection, obstruction, ischaemia and infarction
- To understand the typical imaging appearances of inflammatory bowel diseases
- To understand typical imaging appearances of primary and secondary tumours of the solid abdominal organs and the gastrointestinal tract
- To have a basic understanding of the relative values, common indications, contraindications and limitations of gastrointestinal and abdominal imaging
- To have a basic understanding of how imaging results influence patient treatment

SKILLS

- To delineate the normal imaging anatomy of the abdomen across the different imaging modalities
- To recognise the basic imaging patterns of benign and malignant disease in imaging examinations of the abdomen in correlation with the radiologic report
- To be able to identify clear signs of gastrointestinal perforation or obstruction on radiographs of the abdomen
- To be able to recognise free abdominal fluid on US images

COMPETENCES AND ATTITUDES

- To communicate with patients in order to explain the benefits, risks and basic technical aspects of diagnostic imaging & the most common interventional procedures of the abdomen, e.g., abscess drainage or CT guided biopsy
- To be able to communicate the results of abdominal imaging examinations, whenever necessary under supervision, to patients and their families by the end of the medical studies
- To be able to correctly prescribe the most appropriate imaging examination depending on the clinical situation by the end of the medical studies

U-II-5

GYNAECOLOGICAL AND OBSTETRIC RADIOLOGY**KNOWLEDGE**

- To describe the basic normal anatomy and physiology of the female reproductive organs and how they change with age and during pregnancy
- To have a basic understanding of the main imaging techniques used for gynecological and obstetric imaging, including US, CT and MRI, as well as their indications and relative diagnostic value
- To understand the typical imaging appearances of common benign diseases and of malignant tumours of the female reproductive organs
- To understand the typical imaging appearances of the most common disorders associated with pregnancy and delivery
- To be aware of techniques to reduce exposure doses for radiographic and CT examinations of the female reproductive organs
- To have a basic understanding of the benefits, common indications, contraindications and limitations of gynaecologic and obstetric imaging
- To have a basic understanding of how imaging results influence patient treatment

SKILLS

- To delineate the normal imaging anatomy of the female pelvis across the different imaging modalities
- To recognise basic imaging patterns of benign and malignant disease of the female pelvis in correlation with their description on the radiologic report

COMPETENCES AND ATTITUDES

- To communicate with patients in order to explain the benefits, risks and basic technical aspects of diagnostic imaging & common interventional procedures of the female reproductive organs
- To be able to prescribe (under supervision) the most appropriate imaging technique in pregnant women depending on the clinical question, patient history and other relevant clinical factors
- To be able to communicate the results of a gynaecological or obstetric imaging examination, whenever necessary under supervision, to patients and their families by the end of the medical studies
- To be able to correctly prescribe the most appropriate imaging examination depending on the clinical situation by the end of the medical studies

U-II-6 HEAD AND NECK IMAGING

KNOWLEDGE

- To describe the basic normal anatomy and physiology of the head and neck
- To have a basic understanding of the main techniques used for head and neck imaging, including radiography, US, CT and MRI
- To understand common imaging features of trauma, inflammation and infection of the head and neck region
- To understand typical imaging appearances of tumours of the head and neck region
- To have a basic understanding of the benefits, common indications, contraindications and limitations of head and neck imaging
- To have a basic understanding of how imaging results influence patient treatment

SKILLS

- To delineate the basic normal anatomy of the head and neck region across the different imaging modalities
- To recognise basic imaging patterns of the most common benign and malignant diseases on imaging examinations of the head and neck region in correlation with their description in the radiologic report

COMPETENCES AND ATTITUDES

- To communicate with patients in order to explain the benefits, risks and basic technical aspects of diagnostic imaging & interventional procedures of the head and neck region
- To be able to communicate the results of head and neck imaging examinations, whenever necessary under supervision, to patients and their families by the end of the medical studies
- To be able to correctly prescribe the most appropriate imaging examination depending on the clinical situation by the end of the medical studies

U-II-7 INTERVENTIONAL RADIOLOGY

KNOWLEDGE

- To describe the normal anatomy and physiology of the arterial and venous system and to have an understanding of its relevance to interventional radiology
- To list the more frequent endovascular approaches to common disorders in interventional radiology including the treatment of aortic aneurysms, peripheral vascular disease, venous thromboembolic disease, gastrointestinal bleeding, uterine fibroids, benign prostate hypertrophy and vascular access.
- To understand the common approaches for image-guided biopsy, placement of drains and ablative techniques
- To have a basic understanding of the role of the most common vascular techniques in the treatment of arterial and venous diseases
- To have a basic understanding of the role of interventional radiology in oncology
- To have a basic understanding of the most common non-vascular musculoskeletal, thoracic, breast, gastrointestinal, hepatobiliary and genitourinary interventional procedures
- To have an understanding of the risks involved in the most common interventional techniques
- To list the standard procedures in emergency situations, including patient resuscitation
- To have a basic understanding of the benefits, common indications, contraindications and limitations of interventional radiology
- To understand the importance of consent in interventional radiology procedures and to identify the appropriate person to supply informed consent

SKILLS

- To delineate the normal anatomy of the arterial and venous vessels on DSA
- To observe basic imaged-guided vascular access, vessel catheterisation techniques, angiography and venography
- To observe image-guided biopsy, placement of drainages or ablative techniques

COMPETENCES AND ATTITUDES

- To communicate with patients in order to explain typical and common procedures in interventional radiology
- To communicate the risks and benefits of common interventional radiological procedures to patients and their families
- To be able to discuss with the radiologist the need for an interventional procedure depending on the clinical situation and to be able to subsequently correctly prescribe the most appropriate procedure by the end of the medical studies

U-II-8 MUSCULOSKELETAL IMAGING

KNOWLEDGE

- To describe the normal anatomy and physiology of the musculoskeletal system
- To have a basic understanding of the main imaging techniques, including radiography, US, CT and MRI used in musculoskeletal imaging
- To describe common imaging presentations of trauma involving the skeleton on radiographs
- To describe typical imaging presentations of degenerative disorders of the musculoskeletal system on radiographs
- To understand common imaging appearances of musculoskeletal infection and inflammation, metabolic diseases, including osteoporosis, and common bone tumours
- To have a basic understanding of the common indications, contraindications and limitations of musculoskeletal imaging

SKILLS

- To delineate the normal basic imaging musculoskeletal anatomy across the different imaging modalities
- To be able to detect the common types of fractures on conventional radiographs
- To recognise basic imaging patterns of the most common benign and malignant diseases on musculoskeletal imaging examinations in correlation with their description in the radiologic report

COMPETENCES AND ATTITUDES

- To communicate with patients in order to explain the benefits, risk and basic technical aspects of diagnostic imaging & interventional procedures of the musculoskeletal system
- To be able to communicate the results of a musculoskeletal imaging examination, whenever necessary under supervision, to patients and their families by the end of the medical studies
- To be able to correctly prescribe the most appropriate imaging examination depending on the clinical situation by the end of the medical studies

U-II-9 NEURORADIOLOGY

KNOWLEDGE

- To describe the normal anatomy and physiology of the brain, skull, skull base, spine, spinal cord and nerve roots and how they change with age
- To have a basic understanding of the main techniques used in neuroradiology, including US, CT and MRI as well as their indications and relative values
- To list typical imaging features of ischaemic and haemorrhagic stroke and of the most common vascular diseases on cross-sectional imaging
- To describe the most common imaging features of traumatic brain injury and spinal trauma on cross-sectional imaging
- To understand typical imaging features of white matter disease, inflammation and degeneration on cross-sectional imaging
- To understand the typical imaging features of the most common tumours of the brain and spine
- To understand signs of cord compression on cross-sectional imaging
- To have a basic understanding of neuroradiological interventions including revascularisation and current interventional treatment options for intracranial aneurysms and arteriovenous malformations of brain and spine.
- To have a basic understanding of the benefits, common indications, contraindications and limitations of neuroradiology

SKILLS

- To delineate the basic normal anatomy of the brain and spine on cross-sectional imaging
- To detect and differentiate the different types of intracranial haemorrhage and ischaemic brain features on cross-sectional imaging
- To recognise basic imaging patterns of the most common benign and malignant diseases on neuroradiologic imaging examinations in correlation with their description in the radiologic report

COMPETENCES AND ATTITUDES

- To communicate with patients in order to explain the benefits, risks and basic technical aspects of diagnostic and common interventional procedures of the brain and spine
- To be able to communicate the results of an imaging examination of the brain and spine to patients and their families by the end of the medical studies
- To be able to correctly prescribe the most appropriate imaging examination depending on the clinical situation by the end of the medical studies

U-II-10 PAEDIATRIC RADIOLOGY

KNOWLEDGE

- To describe normal paediatric anatomy and physiology and how it changes with age on conventional radiology, US and cross-sectional imaging
- To have a basic understanding of the main techniques used in paediatric imaging, including radiography, US, CT and MRI, as well as their indications and relative values
- To explain the increased vulnerability of children to ionising radiation
- To have a basic understanding of the typical imaging manifestations of trauma, particularly fractures and differences in patterns of accidental and non-accidental injury
- To list basic imaging features of the most common disorders of the brain, spine, chest, gastrointestinal tract and abdomen, urogenital system and musculoskeletal system in neonates, infants, children and adolescents
- To have a basic understanding of the relative value, common indications, contraindications and limitations of paediatric imaging

SKILLS

- To delineate the normal paediatric anatomy on conventional radiographs and on cross-sectional imaging
- To detect signs of fractures on conventional radiographs in the paediatric age group
- To recognise basic imaging patterns of the most common diseases on paediatric imaging examinations in correlation with their description in the radiologic report

COMPETENCES AND ATTITUDES

- To establish a child-friendly environment
- To communicate with children and adolescents as well as their families to explain the benefits, risks and basic technical aspects of imaging procedures in paediatric radiology
- To be able to communicate the results of an imaging examination, whenever necessary under supervision, to children and adolescents, as well as to their families by the end of the medical studies
- To be able to correctly prescribe the most appropriate imaging examination depending on the clinical situation by the end of the medical studies

U-II-11 UROGENITAL RADIOLOGY

KNOWLEDGE

- To describe the normal anatomy and physiology of the kidneys, ureters, bladder, urethra, male genital tract and retroperitoneum
- To have a basic understanding of the main techniques used in urogenital radiology including radiography, US, CT and MRI, as well as their indications and relative values
- To list typical imaging features of the most common diseases of the urinary tract including lithiasis, urinary obstruction, infection, trauma and tumours
- To understand typical imaging features of the most common pathologies of the prostate, seminal vesicles and testes
- To have a basic understanding of the relative value, common indications, contraindications and limitations in urogenital imaging

SKILLS

- To delineate the normal urogenital anatomy on cross-sectional imaging
- To detect signs of urinary obstruction on US, CT and MRI
- To recognise basic imaging patterns of the most common diseases on urogenital imaging examinations in correlation with their description in the radiologic report

COMPETENCES AND ATTITUDES

- To communicate with patients in order to explain the benefits, risks and basic technical aspects of diagnostic and common urogenital interventional procedures
- To be able to communicate the results of a urogenital imaging examination, whenever necessary under supervision, to patients and their families by the end of the medical studies
- To be able to correctly prescribe the most appropriate imaging examination depending on the clinical situation by the end of the medical studies

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