Clinical Radiology

The Royal College of Radiologists

Undergraduate radiology curriculum

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1. Introduction

With the introduction of the new national Medical Licensing Assessment (MLA), and the inclusion of Clinical Imaging as one of the defined 'Areas of Clinical Practice'; the aim of the undergraduate curriculum is to promote the teaching and learning of the relevant aspects of clinical radiology at undergraduate level, mapped to the presentations and conditions as defined in the MLA content map published by the GMC. The MLA content map is itself based on the GMC publications Outcomes for graduates (2018), the Generic Professional Capabilities Framework (2017) and the UK Foundation Programme Curriculum.

This curriculum will therefore provide a succinct framework that can be used by all UK medical schools to integrate Clinical Radiology (CR) into the undergraduate curriculum. Whilst there are defined areas of learning (divided into presentations and conditions) specified in the MLA syllabus, this curriculum should also allow the flexibility for local expertise and specialist interest to shape education and training delivered to undergraduates.

All undergraduate radiology teaching programs should concentrate on the knowledge, skills and behaviors expected of a newly qualified foundation doctor, and the curriculum content is guided by three themes specified in Outcomes for graduates: readiness for safe practice; managing uncertainty; and delivering person centred care. This will include the knowledge and skills to routinely arrange radiological investigations in the context of the individual patient, and the ability to correctly interpret basic radiological investigations.

With the current global move towards competency and outcomes based medical curricula, this radiology curriculum is based around deliverable Capabilities in Practice (CiPs) which parallels the Clinical Radiology Specialty Training Curriculum.

The syllabus (mapped to the MLA) is divided into:

- Common presentations
- Clinical conditions

Assessment forms an integral part of any curriculum and the new MLA will be assessed with an Applied Knowledge Test (AKT) and a Clinical and Professional Skills Assessment (CPSA). These assessments will be delivered by medical schools as part of their 'finals examinations'.

Whilst the use of radiology and imaging to teach basic anatomy is not part of the MLA syllabus, the integration of anatomy and radiology department teaching is becoming more widespread in UK medical schools, and this curriculum recommends that the teaching of anatomy using imaging should be radiologist led and governed, whilst encouraging active collaboration and shared learning outcomes with academic anatomy departments.

The RCR also recognises that access to teaching and learning opportunities in Interventional Radiology (IR) within the undergraduate curriculum is becoming increasingly important to reflect the expanding role of therapeutic procedures offered by IR in the acute and elective management of many conditions.

The increasing role of simulation training and Artificial Intelligence (AI) will also be referenced in this document.

2. Capabilities in Practice (CiPs)

2.1 Propose and justify appropriate imaging investigation tailored to patient.

Outcome

A medical graduate will refer patients for imaging investigations and/or image guided procedures on an almost daily basis.

Descriptors

- Apply the basic sciences of physics, anatomy, pathology and physiology to anticipate patient preparation for common investigations
- Safely refer patients for imaging investigations taking into account: mobility, allergy status, infection status, drug history and comorbidities
- Understand the legal responsibilities of a doctor as a referrer in context of ionizing radiation
- Understand and follow processes for requesting and discussing imaging priorities, placing patient safety as central to these processes
- Recognise their limitations of knowledge and know when to consult senior colleagues, including to understand indications of an imaging test and the rationale for referral
- Communicate effectively with the imaging team, recognising that requesting imaging is a two-way process
- Communicate rationale/justification for imaging referral in both verbal and written format
- Understand when imaging has a role in health promotion and illness prevention, and the principles underpinning the use of imaging as a screening tool
- Demonstrate knowledge of contrast agents and medications used to optimise imaging quality and/or image guided procedure
- Assess patients with suspected adverse reaction to contrast and initiate appropriate treatment for both moderate and severe allergic reactions/anaphylaxis
- Understand the difference between an allergic reaction to contrast, and the nephrotoxic effect of contrast, and the management of both conditions

Suggested evidence/experience

- CEX with radiologist following interaction for imaging referral
- CBD with radiologist
- OSCE
- Simulation/remote simulation
- Exposure to imaging department to gain insight into the role of a radiologist

Mapping to GMC Outcomes for Graduates (2018)

- Outcome 1: 2, 4, 5 and 8
- Outcome 2: 10, 12-14, 18, 19a
- Outcome 3: 22a

MLA

2.2 Explain common imaging tests and procedures to patients (and/or relatives and carers) to facilitate them making informed decisions regarding imaging investigation and/or management.

Outcome

A medical graduate should be able to explain common imaging investigations so that patients understand and can make an informed and shared decision regarding diagnosis and management of their condition prior to attending for the examination.

Descriptors

- Understand the basic science of the common imaging modalities e.g. ultrasound, radiography, fluoroscopy, CT and MRI
- Understand patient preparation required for common studies
- Understand ionising radiation risk and be able to counsel patients on the risks and benefits of imaging investigations/procedures
- Understand and communicate the specific concerns regarding ionising radiation in paediatric practice
- Understand the use of contrast media and/or medications to optimise imaging studies and contraindications to these
- Understand the use of nuclear medicine studies as a method of 'functional imaging' demonstrating physiological processes

Suggested evidence/experience

- Experience within a radiology department shadowing patients through their imaging journey and/or shadowing radiographers
- Observe interventional radiology case lists.
- OSCE
- CEX
- Simulation/remote simulation

Mapping to GMC Outcomes for Graduates (2018)

- Mapping to GMC Outcomes for Graduates
- Outcome 1: 2, 4, 5 and 8
- Outcome 2: 10, 12-14, 18, 19a
- Outcome 3: 22a

MLA

2.3 Be able to interpret X-ray examinations commonly used in the primary assessment of an acutely unwell patient, and identify basic findings on emergency CT scans.

Outcome

A medical graduate may be the first doctor to clinically assess an unwell patient and should be able to provide a baseline interpretation of plain X-rays to guide onward escalation, investigation and management. They should be familiar with common acute findings on head CT scans.

Descriptors

- Apply anatomical knowledge to interpret chest X-rays (CXR), abdominal X-rays (AXR) and musculoskeletal X-rays.
- Assess for the satisfactory positioning of vascular lines, NG tubes and drains.
- Confidently identify normal CXR and AXR and escalate appropriately if there are concerns of abnormality.
- Identify common causes of acute shortness of breath on CXR
- Identify features of obstruction and/or perforation on AXR
- Identify common fractures and/or dislocations on plain X-Rays
- Identify the different types of intracranial bleed and stroke on CT

Suggested evidence/experience

- OSCE
- CBD
- CEX

Mapping to GMC Outcomes for Graduates (2018)

- Mapping to GMC Outcomes for Graduates
- Outcome 1: 2, 4, 5 and 8
- Outcome 2: 10, 12-14, 18, 19a
- Outcome 3: 22a

MLA

2.4 Formulate an appropriate action plan in response to imaging report findings.

Outcome

A medical graduate is often responsible for ensuring requested imaging tests have been reported and actioned appropriately to facilitate timely diagnosis and management of patients.

Descriptors

- Apply understanding of anatomy, physiology and pathology to interpret imaging reports and the significance of findings
- Understand the role of imaging in reaching a differential diagnosis for patients, but understand the challenge of complexity and uncertainty with regards to imaging interpretation
- Appropriately escalate important imaging findings to their senior team
- Explain findings to patients and their carers/relatives when appropriate
- Communicate effectively with imaging team if clarification of a report is required
- Appropriately manage data in the context of image and/or imaging reports to ensure patient confidentiality

Suggested evidence/experience

- Shadowing junior doctors who are performing these activities on a daily basis.
- OSCE
- CBD
- CEX
- Simulation/remote simulation

Mapping to GMC Outcomes for Graduates (2018)

- Outcome 1: 2, 4, 5 and 8
- Outcome 2: 10, 12-14, 18, 19a
- Outcome 3: 22a

MLA

2.5 Understand the role of interventional and procedural radiology in the therapeutic management of common elective and emergency conditions.

Descriptors

- Understand the range of common diagnostic and therapeutic interventional procedures
- Understand the use of access needles, guidewires, catheters, balloons, stents, drains and embolic agents as the basic tools of interventional radiology practice
- Understand the importance of informed consent before undertaking any invasive procedure
- Understand the importance of patient preparation before any IR procedure. Particularly the importance of clotting parameters, the role of prophylacitic antibiotics, and the use of conscious sedation and local anaesthetic agents
- Understand the purpose and use of the WHO surgical checklist in image guided procedures
- Demonstrate a basic understanding of the types of procedural complications encountered in IR practice
- Understand the importance of post procedural care pathways and observations for detecting procedural related complications
- Apply knowledge of radiation safety to image guided procedures

Suggested evidence/experience

- Simulation
- OSCE
- CEX
- CBD

Mapping to GMC Outcomes for Graduates (2018)

- Outcome 1: 2, 4, 5 and 8
- Outcome 2: 10, 12-14, 18, 19a
- Outcome 3: 22a

MLA

2.6 Understand the role of emerging technologies in radiology

Descriptors

- Understand the expanding role of artificial intelligence and machine learning in the interpretation of imaging investigations
- Understand the need for AI models to undergo a process of training, testing, and validating for use in healthcare
- Understand the use of post-mortem CT in the assessment of cause of death, and the limitations of this technique
- Understand the role of targeted chemotherapy and radiotherapy, and tumour ablation therapies as developing treatment options in interventional oncology
- Understand the use of imaging investigations in clinical research and scholarship, as a tool to assess response to treatments in clinical trials

Suggested evidence/experience

- OSCE
- CBD
- CEX

Mapping to GMC Outcomes for Graduates (2018)

- Outcome 1: 2, 4, 5 and 8
- Outcome 2: 10, 12-14, 18, 19a
- Outcome 3: 22a

MLA

3. GMC Outcomes for Graduates (2018)

3.1 Outcomes that map to radiology

Outcome	Descriptors
Outcome 1	Professional and ethical responsibilities: 2, 4 and 5 Leadership and team working: 8
Outcome 2	Communication and interpersonal skills: 10 Diagnosis and Medical Management: 12-14 Prescribing medications safely: 18 Using information effectively and safely: 19a
Outcome 3	Applying biomedical scientific principles: 22a – f

4. Medical Licensing Assessment (MLA) Content Map

4.1 Guidance for the presentations and conditions to be covered (Mapped to MLA Content Map)

System	MLA Conditions *Be aware of imaging features of MLA conditions on plain film/USS and/or CT.*	MLA Presentations *Be able to select and justify appropriate imaging modalities to evaluate the MLA presentations.*
Neuro	Brain abscess Brain metastases Extra-Dural Haemorrhage Raised ICP Spinal Cord Compression Spinal Fracture Stroke Sub-Arachnoid Haemorrhage Sub-Dural Haemorrhage	Back pain Head Injury Limb weakness Trauma Headache Neck pain Symptoms of raised ICP
MSK	Ankylosing Spondylitis Fractures Soft tissue injury Metastases Non-Accidental Injury Osteoarthritis Osteomyelitis Septic arthritis	Joint pain/swelling Bone pain Trauma Soft tissue injury
GI	Pancreatitis Appendicitis Cholecystitis Cirrhosis Intestinal Obstruction and ileus Perforation Volvulus Surgical site infection Colitis Peritonitis	Abdominal distension Abdominal mass Acute abdominal pain GI Bleeding Jaundice Vomiting

System	MLA Conditions *Be aware of imaging features of MLA conditions on plain film/USS and/or CT.*	MLA Presentations *Be able to select and justify appropriate imaging modalities to evaluate the MLA presentations.*
GU	AKI Cancer Urinary tract calculi UTI	Acute renal failure Anuria Haematuria Scrotal pain PV bleeding Pelvic mass Pelvic pain
Chest	LRTI Lung cancer Bronchiectasis Metastatic disease Pneumonia Pneumothorax Pulmonary Embolism	Breathlessness Chest pain Cough Haemoptysis
Cardiovascular	ACS Aneurysms Ischemic limb Occlusions Aortic dissection Cardiac failure DVT Intestinal ischemia PE	Abdominal distension Abdominal mass Acute abdominal pain GI Bleeding Jaundice Vomiting

System	MLA Conditions *Be aware of imaging features of MLA conditions on plain film/USS and/or CT.*	MLA Presentations *Be able to select and justify appropriate imaging modalities to evaluate the MLA presentations.*
Breast	Breast Cancer	Breast mass Breast screening
Paediatrics	Downs syndrome Epididymitis/orchitis EDH Hernias Intestinal obstruction and ileus Intussusception LRTI NAI Peritonitis Pneumothorax Raised ICP Respiratory arrest Septic arthritis Testicular torsion UTI Volvulus	Abdominal pain Joint pain swelling Breathlessness Child abuse Cough Decreased consciousness Fever Haematuria Jaundice Limp MSK deformities Prematurity Scrotal pain Trauma Vomiting
Oncology	Bladder cancer Breast Cancer Colorectal Tumours Lung Cancer Pathological fracture Raised ICP Spinal cord compression	Misplaced lines/tubes
Trauma	Multiple trauma	Misplaced lines/tubes

Appendices

Medical schools should consider introducing radiologist led imaging teaching to demonstrate the following clinically relevant anatomy. This should run in parallel with established 'pre-clinical' anatomy teaching,with close collaboration between radiology and anatomy departments.

Cardiovascular / Respiratory anatomy teaching	Cardiac anatomy: the chambers, valves, and coronary artery anatomy Vascular anatomy: including the branches of the thoracic and abdominal aorta and the peripheral arteries. Structure of an artery Venous anatomy: the concept of deep and superficial venous systems in the leg Jugular and vena cava anatomy Anatomy of the trachea, bronchi and alveoli Anatomy of the lungs including fissures, lobes and segments Concept of secondary broncho-pulmonary unit (functional anatomy of the lung)
Urogenital anatomy teaching	The kidneys, ureter and bladder Adrenal anatomy Renal artery and vein anatomy Anatomy of the retroperitoneum including nodal groups
Hepatobiliary anatomy teaching	The biliary tree and pancreatic anatomy Mesenteric and portal vascular anatomy (including hepatic artery, portal vein and hepatic vein anatomy) – principles of the portal triad Couinard classification of liver segmental anatomy
GI tract anatomy teaching	The anatomy of the oesophagus, stomach, small bowel and large bowel Principles of foregut, midgut and hindgut embryology in relation to coeliac axis, superior mesenteric artery, inferior mesenteric artery and internal iliac artery vascular supply to the GI tract

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Spinal and thoracic wall anatomy teaching	Spinal anatomy (including vertebral anatomy, cord/cauda equina anatomy and nerve roots, spinal vasculature). Anatomy of the thoracic inlet, first rib/clavicle and subclavian vessels.
Musculoskeletal anatomy	Skeletal anatomy relevant to the common fractures The structure of the major joints and ligaments
Neuro-anatomy	The structure of the cerebellum and cerebral hemispheres Anterior, middle and posterior cerebral artery anatomy and relation to function in stroke. Brainstem anatomy The optic tract and visual cortex The ventricular system and CSF spaces

References

1. General Medical Council. Medical Licensing Assessment. London: General Medical Council.
2. General Medical Council. Outcomes for graduates. London: General Medical Council, 2018.
3. General Medical Council. Generic professional capabilities framework. London. General Medical Council 2017.
4. General Medical Council. UK Foundation Programme Curriculum. London. General Medical Council 2021.
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