ZAMBIA COLLEGE OF MEDICINE & SURGERY

Advancing Specialist Care & Professional Growth

Specialty Training Programme

Curriculum & learning guide

for

RADIOLOGY

Table of Contents

GENERAL INTRODUCTION

This Curriculum and Learning Guide describes the work and competence-based professional training programme for the Specialty Training Programme (STP) in Radiology (RAD) in Zambia. The intended readership for the curriculum and guideline include the following:

- Trainees, host departments and managers of RADIOLOGY healthcare services;
- STP RADIOLOGY trainers, which includes all those involved in supervising, coordinating, assessing and delivering specialist education and training in Radiology;
- Academic, administrative and professional staff within Higher Education Institutions (HEIs), the Higher Education Authority (HEA), and the Zambia Qualifications Authority (ZAQA);
- Strategic partners involved in supporting Radiology care and the training of healthcare practitioners in these related fields.

Zambia College of Medicine and Surgery (ZACOMS) advances professional training of medical specialists using the professional competence-based certification model beyond traditional university-based specialist training. It promotes specialist training as a vital pursuit for a successful professional medical career. The ZACOMS also promotes the increase in universal health coverage (UHC) by promoting equitable access to cost-effective quality specialist care as close to the family as possible for people in Zambia at all levels of socioeconomic status and geographical location. The ZACOMS certifies and admits members and/or fellows as specialists in a medical and/or surgical specialty in any of the various specializations of medicine and surgery.

The Zambia College of Medicine and Surgery (ZACOMS) oversees the training of Radiology specialists working through the College of Radiology of Zambia (CORZ).

Radiology encompasses the diagnostic and interventional imaging procedures in healthcare. The STP RADIOLOGY training provides specialist training in Radiology. This is a relevant programme because of the critical shortage of Radiologists in the country. The STP RAD will equip trainees with core competencies reflecting the wide array of radiological subspecialties. This will mean for every trainee who completes this programme, the population they serve will have gained access to quicker and reliable radiological services. Furthermore, the graduate of this programme will offer support to the various disciplines of medicine, improving outcomes in the management of a broad spectrum of both medical and surgical pathology.

Vision

Our vision is to be innovative in providing a teaching and support structure that will empower every trainee to excel in Radiology knowledge, skills and research through internal and external collaboration.

Mission Statement

The mission of the STP RAD training in Zambia is to train specialists who shall endeavour to improve the Radiology health care services to all by providing safe, evidence-based, humanistic specialist care in the field of Radiology in an efficient and proficient manner to meet the needs of the Zambian community, and contribute to the field of Radiology in the region and globally.

Values:

- Professional excellence
- Integrity
- Sensitivity to reproductive health needs
- Interdisciplinary, inter institutional collaboration
- Continuous professional development
- Innovation
- Academic Excellence
- Self and peer review

RATIONALE FOR THE SPECIALTY TRAINING PROGRAMME IN RADIOLOGY

The STP RADIOLOGY aims to train specialists in Radiology in order to prepare them for specialist service in the healthcare system. The STP Radiology aims to bridge the critical shortage of radiologists by advancing professional training of Radiologists using the competence-based certification model beyond traditional university-based specialist training. Simply put, this model works on the principle that every health facility equipped well enough to support a radiologist practice has the basic requirements to train a Radiologist. The curriculum is therefore informed by the training requirements of the Health Professions Council of Zambia (HPCZ) and the professional creed of the College of Radiology of Zambia (CORZ), and is alive to the unique opportunities obtaining across the various training sites. The training programme encourages self-directed learning, life-long learning, and student-centred approaches while providing robust and structured guidance. The key outcomes are twofold as stipulated in Outcomes 1 and 2.

Outcome 1. Apply at mastery level knowledge in Biomedical Sciences, Behavioural & Sociology, and Scientific Principles to the Practice of Radiology

1. The graduate should be able to apply to Radiology practice biomedical scientific principles, method and knowledge relating to anatomy, biochemistry, cell biology,

genetics, immunology, microbiology, nutrition, pathology, pharmacology and physiology. The graduate should be able to:

a) Explain normal human structure and function relevant to Radiology.
b) Explain the scientific bases for common diseases and conditions' signs, symptoms and treatment relevant to Radiology.
c) Justify and explain the scientific bases of common investigations for diseases and conditions relevant to Radiology.
d) Demonstrate knowledge of drugs, drug actions, side effects, and interactions relevant to Radiology.

2. Apply Scientific Method and Approaches to Radiology Research.
   a) Evaluate research outcomes of qualitative and quantitative studies in the medical and scientific literature relevant to Radiology.
   b) Formulate research questions, study designs or experiments to address the research questions relevant to Radiology.
   c) Discuss and apply appropriate research ethics to a research study relevant to Radiology.

Outcome 2. Competence at mastery level in Radiology Clinical Practice.

On successful completion of the work-based Radiology STP:

1. The trainees should have clinical and specialist expertise in Radiology, underpinned by broader knowledge, skills, experience and professional attributes necessary for independent practice;
2. The trainees should be able to undertake complex clinical roles, defining and choosing investigative and clinical options, and making key judgements about complex facts and clinical situations.
3. The trainees should contribute to the improvement of Radiology services in the context of the national health priorities, by means of outstanding scientific research and application of safe, high quality, cost effective, evidence based practice within the Zambian health system.
4. The trainees should possess the essential knowledge, skills, experience and attributes required for their role and should demonstrate:
   - A systematic understanding of clinical and scientific knowledge, and a critical awareness of current problems, future developments, research and innovation in Radiology practice, much of which is at, or informed by, the forefront of their professional practice in a healthcare environment;
   - Clinical and scientific practice that applies knowledge, skills and experience in a healthcare setting, places the patient and the public at the centre of care prioritizing patient safety and dignity and reflecting outstanding professional values and standards;
   - Clinical, scientific and professional practice that meets the professional standards defined by the Health Professions Council of Zambia (HPCZ);

- Personal qualities that encompass self-management, self-awareness, acting with integrity and the ability to take responsibility for self-directed learning, reflection and action planning;
- The ability to analyze and solve problems RADIOLOGY, define and choose investigative and scientific and/or clinical options, and make key judgments about complex facts in a range of situations;
- The ability to deal with complex issues both systematically and creatively, make sound judgements in the absence of complete data, and to communicate their conclusions clearly to specialist and non-specialist audiences including patients and the public;
- The ability to be independent self-directed learners demonstrating originality in tackling and solving problems and acting autonomously in planning and implementing tasks at a professional level;
- A comprehensive understanding of the strengths, weaknesses and opportunities for further development of Radiology as applicable to their own clinical practice, research, innovation and service development which either directly or indirectly leads to improvements in clinical outcomes and scientific practice;
- Conceptual understanding and advanced scholarship in their specialism that enables the graduate to critically evaluate current research and innovation methodologies and develop critiques of them and, where appropriate, propose new research questions and hypotheses;
- Scientific and clinical leadership based on the continual advancement of their knowledge, skills and understanding through the independent learning required for continuing professional development.

5. Once registered as a specialist in Radiology, a range of career development options will be available including sub-specialist training. Alternatively, others may opt to undertake further career development in post, as specialist, through structured Continuing Professional Development (CPD), provided by Accredited CPD providers. Specialist orthopaedic surgeons who have successfully completed the STP RADIOLOGY will be eligible to compete for available Consultant positions in Radiology.

The outcomes of the STP RADIOLOGY training are affiliated to the following curriculum outcome categories:

Category I: Scientific foundations

Goal 1: Understand the normal structure and function of the human body, at levels from molecules to cells to organs, to the whole organism.
Goal 2: Understand the major pathological processes and their biological alterations.
Goal 4: Understand how the major pathologic processes affect the organ systems.
Goal 5: Integrate basic science and epidemiological knowledge with clinical reasoning.
Goal 6: Understand the principles of scientific method and evidence-based medicine including critical thinking.

Category II: Clinical Skills

Goal 7: Obtain a sensitive, thorough medical history.
Goal 8: Perform a sensitive and accurate physical exam including mental state examination.
Goal 9: Establish and maintain appropriate therapeutic relationships with patients.

Category III: Communication and Interpersonal Skills

Goal 10: Develop the knowledge, skills, and attitudes needed for culturally-competent care.
Goal 11: Participate in discussion and decision-making with patients and families.
Goal 12: Work effectively with other providers in the health system.
Goal 13: Clearly communicate medical information in spoken and written form.

Category IV: Treatment, Acute and Chronic.

Goal 14: Understand therapeutic options and participate in the multidisciplinary care of patients with complex problems.
Goal 15: Recognize acute life-threatening medical problems and initiate appropriate care
Goal 16: Acquire the knowledge and skills necessary to assist in the management and rehabilitation of chronic diseases.
Goal 17: Participate in care in a variety of settings; including knowledge about palliative care.

Category V: Patient Safety

Goal 18: Identify and remove common sources of medical errors.
Goal 19: Understand and apply models of Quality Improvement.
Goal 20: Appreciate the challenges associated with reporting and disclosure.

Category VI: Information Management

Goal 21: Use information and educational technology to facilitate research, education, and patient care.

Category VIII: Ethics, Humanities, and the Law

Goal 22: Develop a commitment to carrying out professional responsibilities, adherence to ethical principles, and sensitivity to diversity.

Goal 23: Develop a critical understanding of the multiple factors that affect the practice of medicine, public health and research.

Goal 24: Incorporate ethical principles in clinical practice and research.

Category IX: Professionalism

Goal 25: Develop healthy self-care behaviours and coping skills.

Goal 26: Model service to patients and community.

Category X: Leadership & Management

Goal 27: Develop interpersonal and communication skills that result in leadership in patient health service delivery and health human resource management.

ADMISSION CRITERIA TO THE SPECIALTY TRAINING PROGRAMME IN RADIOLOGY

Applicants to the STP RADIOLOGY must possess a primary qualification in medicine, that is, Bachelor of Medicine and Bachelor of Surgery (MB ChB) or equivalent, from a recognized university. Additionally, they must have completed internship and retain full registration and a practising licence issued by the Health Professions Council of Zambia. Other Ministry of Health policies and directives, for example, completion of rural posting, may apply.

CURRICULUM DESIGN/MODEL OF THE SPECIALTY TRAINING PROGRAMME IN RADIOLOGY

The STP RADIOLOGY Curriculum is a work and competence-based professional training situated in an accredited training facility managed by specialists in Radiology with oversight by the Zambia College of Medicine and Surgery (ZACOMS) working through CORZ. This curriculum is based on a process model of curriculum and is designed to be flexible and open ended rather than predetermined; maximizing the potential for growth and development.

During the STP RADIOLOGY programme the specialty registrar is an integral member of the clinical work of the department in which they are training to gain the required clinical

experience and competence. The STP RADIOLOGY programme is a work based professional competence-based training leading to the award of the Certificate of Completion of Specialty Training (CCST) by the Zambia College of Medicine and Surgery (ZACOMS). Graduates are then eligible to apply to the Health Professions Council of Zambia to enter the Specialist Registers in Radiology.

TEACHING METHODS IN THE SPECIALTY TRAINING PROGRAMME IN RADIOLOGY

The STP RADIOLOGY training is a work-based professional competence-based programme and should encompass diverse teaching and learning approaches that are appropriate for the target educational domain, i.e., cognitive (knowledge), psychomotor (practical), or affective (attitude) domain. The teaching methods may include, but not limited to, the following: expository lectures, tutorials, seminars, practical classes, skills laboratories, clinical demonstrations, clinical clerkships (bedside teaching, ward rounds, ambulatory care teaching, operating theatre experience, post-mortem, and on-call duties), field and community-based learning, and ICT supported learning experiences.

The Health Professions Specialty Training Guidelines for Zambia and Zambia College of Medicine and Surgery Society Objectives and By-Laws provide detailed guidance to the trainee about the STP and ZACOMS, respectively.

SPECIALTY TRAINING PROGRAMME IN RADIOLOGY CURRICULUM STRUCTURE AND MAP

Curriculum Map for the STP RADIOLOGY Programme

STP YEAR 1 RAD 1011	ZACOMS PT 1 ARCP	STP YEAR 2 RAD 2011	ARCP	STP YEAR 3 RAD 3011	ARCP	STP YEAR 4 RAD 4011	ZACOMS CCST Exams
Radiation Physics (6 Months)		Clinical Radiology (6 months)		Specialist Radiology Rotations (4 Months)		Specialist Radiology Rotations (4 months)	
Imaging Anatomy (6 months)		Clinical Medical Practice (6 months)		Clinical Radiology (4 months)		Specialist Radiology Rotations (4 months)	
				Clinical Medical Practice (4 months)		Clinical Medical Practice (4 months)	

Part 1: Generic Education & Training **(1 year)**	Part 2: Themed & Specialist Education & Training **(3 years)**

N.B. The total number of years, in particular, the themed specialist education and training may vary between different specialties.

1. ARCP = Annual Review of Competence Progression
2. CCST = Certificate of Completion of Specialty Training Examination;
3. STP = Specialty Training Programme;
4. ZACOMS PT 1 = Zambia College of Medicine and Surgery Part 1 Examinations in Basic Sciences, Behavioural Sciences, Health Population Studies, and Professionalism & Ethics; ZACOMS CCST Examinations = Certificate of Completion of Specialist Training in Radiology Examinations

ASSESSMENT IN THE SPECIALTY TRAINING PROGRAMME IN RADIOLOGY

Progression to the next level of training is NOT automatic and is dependent on the trainee satisfying all the competency requirements of each defined level as per this curriculum and learning guide. Progression is based on passing both clinical and written examinations. The assessment framework is designed to provide a coherent system of assessing both formative and summative assessment which are workplace based and in examination settings.

Each training site must ensure that they use valid, reliable and appropriate methods for assessing the knowledge, clinical skills and attitude domains. The continuous assessments and final annual assessments are weighted at 40% and 60% of the final mark of Annual Review of Competence Progression, respectively. Assessment methods may include, but are not limited to, the following: Log of experiences and procedures completed, case reports, portfolios, project reports, multiple choice questions, essay questions, short answer questions, modified essay questions, short and long cases, objective structured clinical examinations (OSCE), practical examinations, objective structured practical examinations (OSPE), Mini-clinical Examination (MiniCEX), and Viva Voce, etc.

It is emphasized that marks from theory examinations **may not** compensate for poor scores in the clinical examinations; Students **MUST** pass the clinical examinations in order to progress to the next stage of training or completion.

Assessment	Knowledge, Skill and Attitude Domain	Examining Body
Formative Workplace Based Assessments	Outcome 1 & 2	Training Site
Annual Review of Competence Progression	Outcome 1 & 2	Training Site in conjunction with ZACOMS

ZACOMS Part 1 Examination	Outcome 1	ZACOMS working through CORZ
ZACOMS Certificate of Completion of Specialist Registration Examinations	Outcome 2	ZACOMS working through CORZ

A candidate shall be allowed a maximum of three attempts for ZACOMS Part 1 and/or Part 2 Examinations. Candidates must have submitted a completed log book to eligible to attempt the ZACOMS Part 2 Examination.

For ease of tracking progress and planning for Radiology care, all STP RADIOLOGY trainees will be registered with ZACOMS and CORZ for the duration of their training and will be allocated a Health Professions Council of Zambia Specialty Registrar Index Number.

Grading Scheme

The STP RADIOLOGY Curriculum and Guide are the basis for all specialty training which contextualize the standards of proficiency set down by the Zambia College of Medicine and Surgery (ZACOMS) in consultation with the Zambia Radiology Association (CORZ) in a way that is accessible to the profession and the public. The Certificate of Completion of Specialist Training (CCST) is not graded. Separate assessments and examinations may be graded to show the level of achievement of the trainee in a particular course or assignment.

Assessment of Attainment of Competence in an Academic Subject

Status & Level	Description of Competence Features	% Range
Outright Fail [D]	• Has poor and inaccurate command of the subject vocabulary • Has poor and inaccurate command of the concepts (knowledge, skills and attitudes) of the subject across a broad range of topics.	44.9% & Below

Bare Fail [D+]	• Has the basics of subject vocabulary • Has the basics of concepts (knowledge, skills and attitudes) of the subject across a broad range of topics • Unable to transfer and apply knowledge, skills and attitudes of the subject in a range of situations. • Unable to exercise independent judgement in a range of situations	45 – 49.9
Clear Pass [C]	• Has sound command of subject vocabulary • Has sound command of concepts (knowledge, skills and attitudes) of the subject across a broad range of topics • Able to formulate responses and demonstrate skill and exhibit appropriate attitude in well-defined and abstract problems/professional settings across a broad range of topics of the subject	50 – 64.9
Meritorious Pass [B]	All of above in level 3 and: □ Able to transfer and apply knowledge, skills and attitudes and exercise significant independent judgement in a broad range of topics of the subject	65 – 74.9
Distinction Pass [A]	All of the above in level 4 and: □ Displays masterly of complex and specialised areas of knowledge, skills and attitudes in a broad range of topics of the subject.	75% & Above

RADIOLOGY HANDBOOK & CURRICULUM

The detailed STP Radiology Handbook and Curriculum is presented in full in the next section.

REGULATIONS FOR ADMISSION TO THE FELLOWSHIP OF THE COLLEGE OF RADIOLOGISTS OF ZAMBIA (CORZ)- FC RAD (DIAG)ZA

The Examination comprises Part I and Part II:
Part II must be passed within six (6) years of passing Part I

INTRODUCTION

The aim of these regulations is to provide the basis to educate, train, develop and finally certify competent Specialist Radiologists for utilization in the provision of comprehensive healthcare services. Whilst the primary responsibility of the College of Radiologists of Zambia (CORZ) is to supply competent Specialist Radiologists for Zambia, CORZ will constantly strive to maintain and promote radiology specialty standards that will achieve universal reciprocity and portability. One of the cornerstones of making diagnosis lies within the field of diagnostic radiology. The form of imaging applied to ailing patients and supported by a consultative, evaluative and advisory competence constitutes a range of services and competencies offered by Specialist Radiologists to clinicians. The combination of raw imaging, evaluative interpretation and a continuously burgeoning radiological knowledge base provided as a 24-hour 365-day service is what constitutes the bedrock of the service provided by Specialist Radiologists. Specialist Radiologists should be prudent and diplomatic not to give the impression that they have assumed exclusive control over what imaging procedures a patient should undergo. To achieve optimal cooperation, they need to inform their colleagues about advances, advantages and drawbacks of radiology. This collaborative approach will provide the mainstay for further advances and development in clinical medical practice. The combination of foci described in the above two paragraphs is the description of the role and responsibility of a Specialist Radiologist at the highest level of abstraction. In the sections that follow, every attempt is made to unpack and unravel what this means in tangible competence terms, and what conditions should be fulfilled to be admitted as a Fellow of the College of Radiologists of the Zambia College of Medicine and Surgery (ZACOMS), register with the Health Professions Council of Zambia (HPCZ) and practice as a Specialist Radiologist in Zambia.

1.0 DEFINING COMPETENCE IN RADIOLOGY

The generic definition of competence is “the condition of being able/capable, adequately capable; have the potential to do something; properly qualified or skilled in something.” This definition is too broad and there are within the context of Radiology the following additional expansion is advocated.

1.1 COMPETENCY IN RADIOLOGY

Radiological competency is the ‘why’ and the ‘how’ a candidate specialist should perform, as she/he might due to his/her potential, subjective cognitive knowledge based and psychological behavioral processes or human-related

attributes; which s/he has (or not have) and must reveal or manifest, in order to effectively accomplish radiological competence.

1.2 COMPETENCE IN RADIOLOGY

Radiological competence is the 'what' the radiology specialty demands of a candidate specialist i.e. the requirements to practice radiology acceptably and safely, and be able to accomplish radiological objectives within the scope of clinical medical practice effectively.

1.3 COMPETENT IN RADIOLOGY

To be deemed competent in radiology entails the eliciting and evaluating of the final state of a candidate specialist's capability, which demonstrates that person's level of effectiveness (performance) as a radiologist against an external norm.

1.4 ADDITIONAL DESCRIPTORS OF COMPETENCE IN RADIOLOGY

The Zambia College of Medicine and Surgery (ZACOMS) further categorizes competence.

These definitions are contextualized to the specialty of radiology as follows:

1.4.1 Fundamental competence: is the competence that is basic to the practice of radiology

1.4.2 Core competence is the competence that characterizes radiology and its practice

1.4.3 Elective competence is the competence that equips for potential expansion and development of radiology and its practice as determined or influenced by projected small changes in the environment. Radiological competence additionally comprises:

1.4.4 Radiological knowledge – demonstrating an intellectual grasp of radiology

1.4.5 Radiological skill – demonstrating technical, cognitive and interpersonal dexterity/adeptness when practicing radiology and when providing a comprehensive clinical imaging service

1.4.6 Attributes of a radiologist – these are the personal and professional qualities and traits that project the individual and contribute to individual and collective professionalism in radiologists.

This further categorization of competence in radiology serves to demonstrate the multidimensional approach that has been used to describe radiological competence as fully as possible.

2 EXIT LEVEL OUTCOMES

The candidate specialist who passes the FC RAD (DIAG) examinations must be able to fulfil the role of a Specialist Radiologist in the medical and academic communities, and in

society at large. Central to these examinations is their licensing function: persons awarded the FZACOR who, in addition, fulfil the other requirements of all relevant health legislation, may register and practice as a Specialist Radiologist in terms of the legislation. The following sections outline the range of competencies that will be expected of the candidate specialist that elects to be evaluated by the ZACOMS in preparation for registration as a Specialist Radiologist in Zambia.

2.1 Interpret and communicate radiological findings. The candidate specialist should be able to:

2.1.1 Detect and interpret radiological signs using all forms of imaging.

2.1.2 Accurately report radiological findings orally and in writing.

2.1.3 Succinctly define clinico-radiological problems and formulate a working diagnosis or suitable differential diagnosis.

2.1.4 Tender appropriate advice to health practitioners/clinicians on the selection of appropriate imaging modalities that will maximize the potential for accurate diagnosis and optimally benefit patient management and care.

2.2 Manage patients and the service in a radiology department .

The candidate specialist should be able to:

2.2.1 Select and, where needed, perform appropriate radiological investigations.

2.2.2 Competently and safely perform radiological procedures.

2.2.3 Be aware of risks and complications of all radiological and related procedures and appropriately manage general emergencies and specifically those that might arise from radiological procedures.

2.2.4 Educate and counsel patients concerning the risk/benefit of radiological investigations and ZACOR

2.5 Practice radiological protection and equipment safety.

2.2.6 Keep adequate radiological records of all practice activities.

2.2.7 Effectively communicate with health care workers in verbal and written format.

2.2.8 Without derogating from the universally accepted prescripts that guide patient care, treat patients in their care with respect and dignity at all times.

2.3 Manage a radiological/clinical imaging service provision. The candidate specialist should be able to:

2.3.1 Identify key elements of a radiological service.

2.3.2 Broadly determine and be able to manage the resources required to sustain a radiological service.

2.3.3 Manage radiology-specific inventory.

2.3.4 Determine the type of radiological and related equipment required and manage them through their life-cycle.

2.3.5 Determine and implement appropriate performance measures that will contribute to the efficient, effective and economic use of resources.

2.3.6 Acquire general competence in management, including service delivery-oriented management.

2.4 Acquire new information and critically evaluate its quality and utility. The candidate specialist should be able to:

2.4.1 Access information using electronic and traditional methods.

2.4.2 Engage in continuing professional development activities. 2.4.3 Critically appraise the quality, relevance and utility of new information.

2.4.4 Appropriately apply newly acquired information to the benefit of their competence specifically and to the radiological services generally.

2.5 Engage in research and personal professional development.

The candidate specialist should be able to:

2.5.1 Produce a fully evaluated (which may include external evaluation) mini-dissertation of between 5 to 10 thousand words, or position papers, or action research papers, on relevant radiological topics of their choice. In the case of papers, acceptance and publication by a peer-reviewed journal would be preferred AND have completed formally structured and evaluated course work as determined by their training centre as part of formative learning.

2.5.2 Manage and produce a completed 'Critical Performance Portfolio' (as determined by ZACOMS) as part of meeting examination entry requirements, as well as a record for continuous professional development.

2.5.3 Continuously pay attention to their personal professional development (attributes), including leadership development, by engaging relevant learning opportunities and interactive forums that will shape their behavior befitting their profession.

2.6 Advise on matters pertaining to health promotion and disease prevention

The candidate specialist should be able to:

2.6.1 Educate and advise patients regarding health promotion and disease prevention.

2.6.2 Demonstrate an awareness of health promotion and disease prevention priorities and strategies.

2.6.3 Tender appropriate advice regarding the usefulness of timely radiological investigations as part of health screening programmes, and the hazards of potential under, mal- or over-subscription of radiological investigations or procedures.

2.7 Play an active role in training other health care practitioners

The candidate specialist should be able to:

2.7.1 Regularly participate in academic teaching activities.

2.7.2 Regularly participate in academic meetings.
2.7.3 Render relevant in-service training to radiation and related practitioners.

2.8 Function as an effective team member in the broad context of health care

The candidate specialist should be able to:

2.8.1 Treat all health care workers with respect.
2.8.2 Recognize the roles other health care workers play; consult appropriately.
2.8.3 Provide leadership when called upon to do so or when the situation demands it.

3.0 LEARNING OUTCOMES

Candidate specialists preparing for the examination are advised to pay attention to the following aspects of learning and professional development.

3.1 KNOWLEDGE

The candidate specialist should acquire knowledge of/in:

3.1.1 A broad overview of the principles and applications of imaging in clinical practice.
3.1.2 Normal imaging anatomy of all organs and systems of the human body.
3.1.3 Understanding of the role that imaging plays in diagnosis and intervention of common clinical problems.
3.1.4 Radiation biology, protection and safety.
3.1.5 Radiological signs and findings of common clinical conditions and diseases found in South African hospitals and practices.
3.1.6 Indications, contraindications and complications of radiological procedures and interventions.
3.1.7 Human rights and the principles of medical ethics and good clinical practise.
3.1.8 Medico-legal aspects of health care in South Africa, with special emphasis on radiation medicine.
3.1.9 Principles of radiological audit, quality assurance and utilisation of radiological management information.
3.1.10 Principles of research methods, inclusive of statistical analysis.
3.1.11 The management of a radiological service to patients and health workers, including service delivery-oriented management
3.1.12 Knowledge of implements, instruments and specific-ware used in diagnostic and therapeutic procedures.

3.2 SKILLS

The candidate specialist should acquire and continuously refine the following skills:

3.2.1 Specific skills - Investigative, deductive and logical decision-making
- observation, orientation and illustration
- building a body of evidence and warrants

- synthesis
- guarded decisiveness
- measured approach to taking action
- framing, inquiring, advocating and reflecting

3.2.2 Diagnostic and therapeutic interventional procedures

- above-average hand-eye coordination
- synchronised application of sensory (visual and auditory) and motor (hands, arms and feet) functions
- leveraging the capacity in radiological equipment and technology to derive the best results
- choice of implements, instruments and supporting-ware used
- observe and monitor multiple monitors simultaneously (visually and aurally), including the patient directly

3.2.3 Communication

- oral: appropriate to patients, public, health care workers and academic audiences
- written: report production, record keeping, referral letters, medical reports and academic writing

3.2.4 Information management

- data access using traditional and electronic techniques
- critical appraisal of information sources and information

3.2.5 Research

- critical appraisal of research methods
- analysis and interpretation of data
- formulating a research report

3.2.6 Teaching and training

- education of patients and communities
- teaching and training of students and fellow colleagues

3.2.7 General skills

- Leadership
- Management
- Interpersonal

3.3 Attributes

These encompass professional and personal attributes, most of which are described broadly below and should be reflected in the performance portfolio through the continuous assessment process of the training institutions.

3.3.1 Constantly learn and develop attributes that promote conduct that befits the highest order of professionalism.

3.3.2 Respect for the rights and values of others; treat everyone with dignity. 3.3.3 Open mindedness, capacity for self-reflection and critical appraisal.

3.3.4 Insight into personal strengths and recognition of personal limitations.

3.3.5 Ability to recognize and deal effectively with personal stress.

3.3.6 Ability to care for oneself, including seeking health care when needed.
3.3.7 Discipline and insight to continue learning to maintain a high level of clinical competence.
3.3.8 Dedication to serving the interests of patients at all times.
3.3.9 Promotion of justice and equity in the health care system.
3.3.10 Maintenance of integrity and honesty in professional practice.

4.0 Admission to the Examinations

- The ZACOMS (through the Examinations and Credentials Committee) will review every application for admission to the examination (including professional and ethical standing) of each candidate.
- There are 2 parts to the examination: part II must be completed within 6years of completing part I. Failure to comply will require that the entire part I examination be repeated.
- Part I can only be repeated 3 times in total.
- Both Part I subjects must be attempted in the initial examination sitting, but individual subjects can be 'carried' for a further two attempts if candidates are not successful in one subject.

4.1 Admission to Part I (Radiation physics and imaging anatomy):

4.1.1 Candidates must be registered at least as medical practitioners with a national medical council.

4.2 Admission to Part II:

4.2.1 Candidates may be admitted to Part II of the examination having completed 36 months training as a radiology registrar in an HPCZ recognized post (including supernumerary posts) AND have successfully completed both parts of or be exempt from Part I of the examination (exemption will be granted for candidates supplying appropriate proof of having succeeded in the MMed Radiology Part I examinations in Physics and Anatomy at an HPCZ -accredited university training centre) AND have completed the relevant sections of the performance portfolio, including a satisfactory continuous assessment certified by the head(s) of department of the training department(s) (or equivalent) (An acceptable portfolio will be certified by the ZACOMS and returned to the candidate).

4.2.2 Supervisors' approval of the candidate's Portfolio

5.0 Format of the Examinations:

5.1 FC RAD(DIAG)ZA Part I

- Radiation Physics will be in the form of a 3-hour written paper (that may include multiple choice questions)
- Imaging Anatomy will be in the form of two or three spot tests (200 spots in total) involving identification of anatomy on relevant diagnostic images

as well as providing knowledge of radiographic views, imaging technique and relevant physiology.

5.2 Recommended Reading for the FC RAD (DIAG) ZA Part I (See Indicative Resources)

5.3 FC RAD (DIAG)ZA Part II

5.4 **5.3.1 Written examination**:

Three written papers of 3 hours each dealing with clinical radiology and clinical medical practice (including current principles and practice as well as advances in the field).

Emphasis will be on short answers and multiple choice questions will remain an option.

5.3.2 Rapid Reporting examination:

A one-hour examination comprising forty images of typical Trauma/Emergency Unit plain X-ray investigations, including normal studies

5.3.3 Long Case Reporting examination:

Interpretation of radiological images and generation of an appropriate report. Cases will be presented in digital format. Five stations of 20 minutes will be included.

5.3.4 Oral examination:

The candidate will be evaluated on all aspects of radiology as applied to current clinical practice. The emphasis will be on assessing the radiological knowledge, skills in interpretation and synthesis of a diagnosis, as well as the ability to communicate findings in a clear concise manner. Other professional skills and attributes will also be evaluated. The examination comprises (at least) two sessions of up to 15 minutes each.

5.4 Recommended Reading and Electronic Media for FC RAD(DIAG)ZA, see curriculum

6.0 Performance in the examinations

6.1 Candidates must achieve 50% for both Physics and Anatomy to pass. These contribute equally to the final mark ie 50% each.

6.2 These subjects must be written together at the first attempt.

6.3 If 50% or more is achieved for only one subject, this subject need not be repeated for

2 further attempts. (Note that this includes attempts in MMed Part I Anatomy or Physics).

6.4 A total of 3 attempts only are allowed for Part I (irrespective of whether a subject is being carried or not) This also includes attempts at MMed Part I Anatomy or Physics, which must be declared on application to sit the examinations).

6.5 Candidates need to have completed the performance portfolio (log book) including a certified adequate continuous assessment by the relevant head of department (or equivalent) to apply for Part II of the examination. The

performance portfolio needs to be submitted with the application to enter for Part II.

6.6 The performance portfolio will be assessed by the current convenor with guidance from a moderator where necessary and support from the ZACOMS council in questionable circumstances.

6.7 Candidates entering for Part II need to achieve an overall mark of 50% or more for the Written component of the examination to proceed to the Long Case Reporting and Oral components (ie a mark of less than 50% for the written component of Part II is a failure for the candidate and the examination has to be repeated at the next sitting). In addition, candidates need to achieve a 60% subminimum for the Rapid Reporting component to allow entry to the Long Case Reporting and Oral Components.

6.8 At least 2 pairs of examiners participate in the oral examination.

6.9 An overall assessment of Part II will be submitted as a percentage for each candidate in accordance with the ZACOMS regulations.

6.10 The overall breakdown of component contribution towards the overall total mark is as follows:

- Written (including Rapid Reporting) 25%
- Long Case Reporting 25%
- Oral A 25%
- Oral B 25%

6.11 To pass the Part II the following are required:

6.11.1 A 50% subminimum for the written component is required to allow entry to the Long Case Reporting and Oral components

6.11.2 A 50% subminimum for the Rapid Reporting component is required to allow entry to the Long Case Reporting and oral components

6.11.3 An overall 50% subminimum for the Long Case Reporting session

6.11.4 A 50% subminimum for over half of the cases in the Long Cases Reporting session (ie at least 50% to be achieved in 3 of a total of 5 cases)

6.11.5 A 50% subminimum for the two oral examinations combined. A 40% subminimum for each of the Oral examinations (examiner pair)

6.11.6 An overall total mark of 50% or more

6.11.7 There is no limit to the number of attempts allowed for Part II but this must be achieved within 6 years of obtaining Part I, or the candidate will be required to repeat Part I.

6.11.8 Candidates who achieve the required 50% in the Written component of the examination AND The required 50% for the Rapid Reporting component, but who fail the Long Case Reporting session and/or the Oral examination will be exempt from the Written Rapid Reporting components of the next examination. Such exemption applied to one sitting only and must be exercised in the following semester.

1.0 CORE CURRICULUM FOR THE PART I CORZ EXAMINATION

Candidates are expected to have a comprehensive knowledge reflecting radiological and imagining anatomy and physics of medical imaging.

1.1 Physics and Imaging

1.1.1 Basic concepts of radiation physics o electromagnetic radiation o wave-particle duality o electromagnetic spectrum o energy of photons

1.1.2 Production of x-rays o continuous radiation of Bremsstrahlung

- characteristic radiation
- effect of variation of: kV, mA, filtration, voltage waveform
- X-ray tubes: types, construction, line focus principle, heel effect, tube rating

1.13 X-ray generators o generator types and waveforms: single phase, 3 phase, 6 and 12 pulse, medium frequency, capacitor discharge, battery operated

- effect on radiation output o effect on image quality o exposure times
- automatic exposure control

1.1.4 Interactions between x-rays and matter o coherent scatter

- photoelectric effect and characteristic radiation
- Compton scatter o pair production
- attenuation: linear attenuation coefficient, half value layer, factors affecting attenuation
- factors affecting scattered radiation – kVp, field size, collimation, filtration, subject thickness, film-focus distance

1.1.5 Filters, collimators, grids o inherent filtration o added filtration o K-edge filters

- methods to reduce scatter: collimation, compression, grids, air gaps, compression etc

1.1.6 Luminescent screens o principles of action

- absorption and conversion efficiency o intensification factor
- speed
- types of phosphors: advantages and disadvantages

emission
spectrum
resolution
response to Kv

1.**1.7 Characteristics of x-ray film and film processing**

- structure of film
- film speed, sensitivity and specificity
- film processing

1.1.8 Photographic characteristics of x-ray film

- optical density and the grey-scale
- characteristic curve and contrast
- speed
- spectral sensitivity of emulsions
- emulsion types: single, double

1.1.9 Image system performance

- contrast and contrast resolution: subject contrast, film contrast, radiographic contrast,
- fog and scatter, dynamic range
- spatial resolution: sharpness, line spread function, modulation transfer function
- noise: systemic, random, quantum mottle, signal to noise ratio
- geometry: magnification, focal spot size, distortion

1.1.10 Image intensification

- intensifier design
- intensifier operation
- performance factors

1.1.11 Standard x ray system

- design and construction
- generators
- transformers
- cables
- operator console
- tube mountings
- tables
- bucky systems

- general layout of an X-ray room

1.1.12 Fluoroscopy TV systems

- video camera performance factors
- video monitor characteristics
- high resolution TV systems
- spot film cameras
- CCD systems

1.1.13 Conventional tomography

- principles
- techniques

types of tomography including panoramic practical application

1.1.14 Mammography

- basic principles of soft tissue and breast imaging
- types of mammography x-ray units
- emission spectra with different anode and filter materials e.g. molybdenum tube and filter
- geometric unsharpness as a limiting factor o recording system: film screen, digital
- magnification techniques
- alternative breast imaging:radionuclide imaging , US, MRI o principles and applications of stereotaxis o breast Tomosynthesis and Elastography

1.1.15 Principles of computers o terminology: pixels, matrix, bits, bytes, display levels (bits per pixel), storage technology and requirements

- central processing unit, key board, video display unit o mass storage devices: tape, CD, DVD, MOD
- input and output devices o network principles
- working understanding of DICOM standards o basic and middle computer literacy

1.1.16 Computed tomography o basic principles

- data acquisition: X-ray tubes, collimators, detectors-types and efficiency, o sampling frequency, calibration techniques o geometry: generations, spiral, multi-slice technology
- image reconstruction and display: basic principles (voxel and pixels), various o reconstruction algorithms, window width and level

- image quality: spatial resolution, contrast resolution, spatial uniformity, noise, effect of
  pixel size, slice thickness, mA, algorithm, sampling frequency, field of view, pitch,
- collimation.
- artefacts: partial volume, motion, beam hardening, ring artefact, spiral scan artefacts etc
- CT fluoroscopy
- tissue density and characterisation and the Hounsfield scale o dual energy CT

1.1.17 Computed radiography

- digital fluoroscopy: pulsed fluoroscopy o computed radiography
  flat panel detectors digital
  subtraction techniques

equipment requirements: tube, generator, image intensifier, TV chain, processing

- digital imaging processing o computer radiography systems [CR] o direct radiography systems [DR]
- patient archiving and communication systems [PACS] o radiology information systems [RIS] o dual energy x-ray absorptiometry (DEXA)

1.1.18 Magnetic resonance imaging

- basic principles
- relaxation T1, T2,
  T*
- pulse sequences: spin echo, inversion recovery and STIR, fast imaging-gradient echo,
- EPI, fast spin echo
- image production: gradient fields, slice thickness, bandwidth, phase encoding gradients,
- readout gradients, Fourier transformation techniques etc o image quality: signal to noise ratio, spatial resolution, artefacts o flow effects: flow void, flow imaging
- equipment: magnets, gradient coils, RF coils, computer systems o magnetic resonance angiography techniques: diffusion, perfusion, functional, o MR spectroscopy.
- hazards and bio effects
- environmental problems: shielding

1.1.19 Radionuclide imaging

- basic atom structure and radioactivity

- measurement of radiation and radioactivity: detector types, detector geometry and o efficiency
- imaging systems: gamma camera principles, single photon energy computed tomography
- (SPECT), dual energy x-ray absorptiometry (DEXA) positron emission tomography
- (PET), hybrid PET, PET CT
- radio-pharmaceuticals: production, characteristics, labelling, production, half-life, o isotopes used in clinical practice

1.1.20 Ultrasound o basic principles of ultrasound and interaction with matter: wave physics, wave length,

- frequency, phase, intensity, amplitude, decibel measurement, velocity in liquids and tissues, acoustic impedance, interference, diffraction, resonance, reflection, refraction attenuation, absorption, scattering
  transducers: piezoelectric effect, design, beam pattern, focus, broad bandwidth transducers
- pulse echo imaging: A, B, M modes, grey scale, dynamic range, receiver functions, time gain
- compensation (TGC), compression amplifier
- digital processing: scan converter, pre and post processing, image display and recording
- real time ultrasound: principles, linear, convex, phased, annular arrays o Doppler ultrasound: Doppler effect, continuous and pulsed wave instruments, duplex
- systems, colour Doppler, power Doppler
- ultrasound artefacts: reverberation, attenuation-shadowing and enhancement, refraction sound
- speed error, beam width-side lobes, instrument artefacts
- biological effects: interaction of sound and tissues, measurement of power output and
- intensity, methods of dose reduction, safety recommendations. o new and evolving techniques
-

1.1.21 Radiation biology

- radiation units: exposure, absorbed dose-gray, equivalent dose-sievert, effective dose sievert
- dose: skin, organ, integral doses
- interaction mechanisms: ionisation, excitation, free radicals, linear energy transfer
- mutation: spontaneous, radiation induced, dose rate dependence, genetically significant
- dose, doubling dose

- effect on chromosomes: types of damage, influence of dose, results of damage
- radiation induced cancer
- effect on the embryo and foetus

- risk of occupational exposure

1.1.22 Radiation protection o

- biological effects; stochastic, non-stochastic, deterministic, weighting factors
- measurement of detriment
- International Commission on Radiation Protection(ICRP) recommendations and
- radiation protection
- dose limits: occupational, public, pregnant women
- methods to reduce dose to occupationally exposed workers and the public: x ray
- equipment, radioactive materials o methods to reduce dose to patients
- methods of assessing radiation dose: dosimetry, film badge dosimeters, thermoluminescent
- dosimeters
  radiation doses for common procedures

1.1.23 Quality assurance and control

This entails identifying the critical aspects that affect the quality of radiological procedures and techniques e.g. universally accepted conventions and/or departmentally tailored/customized protocols, besides those addressed above, that can be directly controlled.

QA & C in general radiography and fluoroscopy including fluoroscopy in specialized

- imaging procedures
- QA & C in radionuclide
  imaging
- QA & C in MR scanning o QA
  & C in CT scanning
- QA & C in ultrasound
- QA & C in Mammography
- QA & C in interventional
  Radiology

1.1.24 Artefacts

- plain radiography
  artefacts
- developing artefacts
- ultrasound artefacts

- CT artefacts
- MRI artefacts
- digital and reconstruction artefacts

1.1.25 Basic statistics and research

components of a scientific publication / presentation

- literature searches
- ethical issues pertaining to research
- cohort o sensitivity
- specificity
- positive predictive value
- negative predictive value
- accuracy
- prevalence
- incidence
- confidence interval
- inter, intra-observer variability
- Kappa statistic
- variables
- Chi squared test
- student T test
- Mann Whitney test
- P value
- meta-analysis
- reviews

2.0 Radiological anatomy and technique

Candidates will be expected to have a comprehensive knowledge of all aspects of imaging anatomy demonstrated by current imaging techniques:

- knowledge of developmental anatomy, as well as common developmental anomalies and variations of normality is expected;
- knowledge of and be familiar with cross sectional and multi-planar (CT and MR) as well as sonographic anatomy and knowledge of common imaging
- procedures used in daily practice of radiology in Zambian hospitals, their indications, contraindications, complications is required

2.1 Radiological and imaging anatomy

2.1.1 Head and neck

A comprehensive understanding of the cross-sectional imaging anatomy of the skull base, brain, orbits, paranasal sinuses and middle ear is required. The vascular anatomy both

arterial and venous of the brain, skull, orbits and facial structures is required. The lymphatic drainage and position of important lymph nodes must be known.

2.1.2 Spine

A detailed imaging knowledge of the cross sectional and longitudinal anatomy of the spine, spinal cord, coverings and spaces, cauda equina and nerve roots is required.

2.1.3 Chest and heart

A detailed knowledge of the anatomy of the lungs, mediastinum and heart is required.
The vascular anatomy including cardiac anatomy using all modern modalities including multidetector CT is required.

2.1.4 Abdomen

A detailed anatomy of the cross sectional imaging anatomy of the abdomen is required including MRI.
This includes the solid organs of the liver, spleen, pancreas as well as the hollow organs of the gastrointestinal system, their vascular supply and lymphatic drainage.
The biliary anatomy and variations are required.
The intra and extra-peritoneal spaces, their formation and anatomy is required.

2.1.5 Pelvis and genitourinary tract

A comprehensive knowledge of the cross sectional imaging, vascular supply and lymphatic drainage of the kidneys, ureters, bladder and urethra is required.
Knowledge of the anatomy of the prostate and male reproductive tract is required. Knowledge of the anatomy of the female reproductive tract is required. The pelvic peritoneal reflections and spaces are also required.

2.2 Specific Organ and System Anatomy

2.2.1 Obstetrics

Knowledge of the embryological and foetal development and the modern imaging anatomy and investigations of the embryo, foetus, placenta, umbilical cord and uterus and ovaries in pregnant patients is required, including the ageing of the foetus.

2.2.2 Breast

The imaging anatomy of the breast is required with a comprehensive knowledge of the various imaging modalities available to image the breast, including MRI.

2.2.3 Endocrine System

A comprehensive knowledge of relevant anatomy of all organs of endocrine system is required.

2.2.4 Musculoskeletal System

Multi-modality based knowledge of the imaging anatomy of bones, joints, muscles, tendons and ligaments, is required. The principles and methods of determining the age of a person is obligatory.

2.2.5 Vascular System

A comprehensive knowledge of the imaging investigation of the arteries, veins and lymphatic systems is required. Knowledge of modern imaging of the vascular system including MRA, MRV and CTA is required.

2.2.6 Dentistry

Knowledge of the anatomy of teeth, their development, and imaging and identification is required.

2.3 Radiological Technique

The full scope of all imaging modalities will require focus as they are relevant to the procedure to be performed

.

- For a full scope refer to the Log book by the Zambia College of Radiologists o This will apply equally to the preparation/vetting of the patient and the examination room, the nature of the procedure, the specific requirements of the techniques, the choice of contrast agent, common pitfalls of the procedure, risks and precautions specific to the procedure, complications associated with the procedure where relevant, and the necessary aftercare.
- The full range of methods of imaging used shall include the utilisation of spot xray technique,

ultrasound, fluoroscopy, radionuclide imaging, computed tomography, magnetic resonance imaging and positron emission tomography (where available). o Conventions and protocols where relevant should be emphasised. o The different and most appropriate form of image capture must also be considered as integral to the procedure.

- Key aspects of what should be contained in a radiology report as obligatory are also necessary.

2.3.1 Contrast Agents in Imaging

- basic principles: chemical structure, pharmaceutical actions and toxicity
- types of contrast agents: anatomical space specific e.g. intravascular, subarachnoid, gastrointestinal;
- imaging specific e.g. ultrasound and MRI
- applications: fluoroscopic, ultrasound and MR imaging
- adverse reactions and their treatment

2.0 CURRICULUM FOR THE PART II CORZ FELLOWSHIP EXAMINATION

The candidate will be expected to have comprehensive knowledge of:

- The role of various imaging techniques in the diagnosis of specific diseases
- The imaging techniques currently available in South Africa to demonstrate both pathological and physiological processes
- The equipment required to perform imaging techniques
- The safe use of contrast media including the management and prevention of complications
- The systematic examination, interpretation and oral and written communication of images together with a differential diagnosis and correlation of imaging findings.
- Physiological processes relating to physiological imaging

1.1 Clinical Radiology

There are fifteen themes that focus on the areas of knowledge to be acquired.

For the first twelve themes the candidate specialist is expected to acquire comprehensive knowledge of the macroscopic pathology, clinical signs and imaging findings of the disease processes, progressive pathophysiology and the diagnostic signs including prognostic signs associated thereto.

The last two themes entail combining the competence of a Specialist Radiologist with a service delivery-oriented manager bringing them together into an all-inclusive pragmatic whole for the benefit of clinicians and their patients.

1.1.1 Neuroimaging (brain and spinal cord)
1.1.2 Head and Neck imaging
1.1.3 Chest imaging
1.1.4 Cardiac imaging
1.1.5 Breast imaging
1.1.6 Gastro-intestinal imaging
1.1.7 Hepato-biliary and pancreatic imaging
1.1.8 Genito-urinary tract imaging
1.1.9 Musculoskeletal imaging
1.1.10 Vascular imaging
1.1.11 Obstetric and gynaecological imaging
1.1.12 Paediatric imaging
1.1.13 Emergency and trauma imaging
1.1.14 Therapeutic radiology and interventional radiology
1.1.15 Management of a radiological/clinical imaging service
1.1.16 HIV and TB (Infectious disease imaging)
1.1.17 Physiological imaging and pathophysiology relating to imaging

2.0 Clinical Medical Practice

This component of radiology recognises and advocates that the practice of radiology correlates intimately with clinical management of the patient. This includes linking relevant aspects of the history, clinical examination and laboratory investigations and findings to the choice of the diagnostic investigation or series, the provision of a plausible differential diagnosis and the making of accurate diagnosis. The point of departure of this area of competence in radiology stems from the complete and comprehensive management of the patient's condition, coupled with a service-based approach to fellow clinicians in their quest to alleviate morbidity and to contain mortality. In its expanded form, this competence requires that the following areas of focus are developed and honed.

- Be able to make accurate interpretation of history, clinical examination and laboratory investigations and findings.
- Possess a broad knowledge base of and clinical acumen in disease states, and the role of radiology in their diagnosis and management.
- Formulate logical approaches to clinical conundrums and the ability to formulate systematic and/or systemic course/s of action that will benefit clinical knowledge, patient management and clinical outcomes, inclusive of influencing or determining prognosis.
- Provide regular or walk-in consulting and advisory services, inclusive of conducting scheduled clinicoradiological meetings and discussions, which could finally culminate in credible publications of findings.

INDICATIVE RESOURCES

Resource List for CORZ Part I and II examinations:

Part I: Physics

The Essential Physics of Medical Imaging [Hardcover]
Jerrold T. Bushberg (Author), J. Anthony Seibert (Author), Edwin M. Leidholdt Jr. (Author), John M. Boone(Author)
ISBN-10: 0781780578 | ISBN-13: 978-0781780575 | Publication Date: December 20, 2011 | Edition: Third, North American Edition

Review of Radiological Physics [Paperback]
Walter Huda (Author), Richard M. Slone (Author) ISBN-10: 0781736757ISBN-13: 9780781736756

Part I: Anatomy

Anatomy for Diagnostic Imaging [Paperback]
Stephanie Ryan (Author), Michelle McNicholas (Author), Stephen John Eustace (Author)
ISBN-10: 0702029718ISBN-13: 978-0702029714
Imaging Atlas of Human Anatomy [Paperback]
Jamie Weir (Author), Peter H. Abrahams (Author), Jonathan D. Spratt (Author), Lonie R. Salkowski (Author)
ISBN-10: 072343457 ISBN-13: 978-0723434573
Applied Radiological Anatomy [Hardcover]
Paul Butler (Editor), Adam W. M. Mitchell (Editor), Harold Ellis (Editor)
ISBN-10: 0521481104ISBN-13: 978-0521481106
See Right Through Me An Imaging Anatomy Atlas
Andronikou, Savvas1st Edition., 2012, Approx. 600 p. 1600 illus. in colour. New edition pending
Publisher: Springer-Verlag Berlin and Heidelberg GmbH & Co. K
Published: 17 June 2012Format: Hardback 600 pages
ISBN 13: 9783642238925 ISBN 10: 3642238920
Atlas of Normal Roentgen Variants That May Simulate Disease: Expert Consult - Enhanced Online Features and Print, 9e [Hardcover]
Theodore E. Keats MD (Author), Mark W. Anderson MD (Author) Publication Date: May 30, 2012| ISBN-10: 0323073557 | ISBN-13: 978-0323073554| Edition: 9

Electronic resources part I anatomy:
E anatomy http://www.imaios.com/en/e-Anatomy

Part II:
Core reading - general:

Grainger & Allison's Diagnostic Radiology: Expert Consult: Online and Print, 5e (2 Vol Set) [Hardcover]
Andy Adam (Author, Editor), Adrian K. Dixon (Author, Editor), Ronald G. Grainger(Editor), David J. Allison (Editor)
Publication Date: September 25, 2007| ISBN-10: 0443101639 | ISBN-13: 9780443101632| Edition: 5
Textbook of Radiology & Imaging (2-Volume Set)
Dr. David Sutton MD FRCP FRCR (Author)
Publication Date: May 15, 1998 | ISBN-10: 0443053685 | ISBN-13: 978-0443053689 | Edition: 6th

Alternative reading - general:

Fundamentals of Diagnostic Radiology - 4 Volume Set (Brant, Fundamentals of Diagnostic Radiology)
William E Brant (Author), Clyde Helms (Author)

Primer of Diagnostic Imaging: Expert Consult- Online and Print, 5e (Expert Consult Title: Online + Print)
[Paperback]
Ralph Weissleder MD PhD (Author), Jack Wittenberg MD (Author), Mukesh MGH Harisinghani MD (Author),
John W. Chen MD PhD (Author)
Publication Date: August 17, 2011 | ISBN-10: 0323065384 | ISBN-13: 978-0323065382 | Edition: 5

Supplementary and subspecialty reading:

Neuro:
Diagnostic Neuroradiology: A Text/Atlas, 1e [Hardcover]
Anne G. Osborn MD (Author)
Publication Date: January 15, 1994 | ISBN-10: 0801674867 | ISBN-13: 978-0801674860 | Edition: 1

MSK and Trauma:
Orthopedic Imaging: A Practical Approach [Hardcover]
Adam Greenspan (Author)
Publication Date: October 4, 2010 | ISBN-10: 1608312879 | ISBN-13: 978-1608312870 | Edition: Fifth,
North American Edition

The Radiology of Skeletal Disorders: Exercises in Diagnosis (Vols 1-4) [Hardcover] Ronald O. Murrayhttp://www.amazon.com/Radiology-Skeletal-Disorders-Exercises in Diagnosis.
Murray (Author), Harold G. Jacobson(Author), Dennis J. Stoker (Author)
Publication Date: March 1990 | ISBN-10: 0443019800 | ISBN-13: 978-0443019807 | Edition: 3 Sub

Radiology of Skeletal Trauma (2-Volume Set) [Hardcover]
Lee F. Rogers MD (Author) Publication
Date: January 15, 2002 Book Series:
Diagnostic Imaging series
Requisites series

Electronic sources:
Auntminnie (www. auntminnie.com);
Radiopaedia (www.radiopaedia.org);
ACR Case in Point (http://3s.acr.org/cip/Calendar.aspx);
Learning Radiology (www.learningradiology.com);
CTisus (www.ctisus.com);
Medpix (www. rad.usuhs.edu/medpix);
MyPACS.net (www.mypacs.net);
Michigan State University Teaching Cases;
(https://horizon.rad.msu.edu/studyshare/repos/studyshare_repo/static/e/home/index.htm);
Neuroradiology Interesting Cases (http://www.urmc.rochester.edu/smd/rad/ncases.htm);
Radiolopolis (http://www.radiolopolis.com/index.php/radiology-cases/radiologyteaching-files.html)
RADPRIMER /STAT DX / RIT-I – recommended but require subscription.