CMSA

The Colleges of Medicine of South Africa NPC
Nonprofit Company (Reg. No. 1955/000003/08)
Nonprofit Organisation (Reg No 009-874 NPO)
VAT Number: 4210273191
27 Rhodes Ave, PARKTOWN WEST 2193
Private Bag X23, BRAAMFONTEIN 2017
Tel: +27 11 726-7037/8/9
Fax: +27 11 726-4036

General: admin@cmsa.co.za
Academic Registrar: academic.registrar@cmsa.co.za
Website: www.cmsa.co.za

JOHANNESBURG
ACADEMIC OFFICE

November 2017

R E G U L A T I O N S

FOR ADMISSION TO THE FELLOWSHIP OF THE COLLEGE OF

RADIOLOGISTS OF SOUTH AFRICA

FC Rad Diag(SA)

The examination comprises Part I and Part II: Part II must be passed within eight (8) years of passing Part I

INTRODUCTION

The aim of these regulations is to provide the basis to educate, train, develop and finally certificate competent Specialist Radiologists for utilisation in the provision of comprehensive healthcare services. Whilst the primary responsibility of the College of Radiologists of South Africa (C Rad SA) is to supply competent Specialist Radiologists for South Africa, the C Rad SA 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 C Rad SA, of the CMSA register with the Health Professions Council of South Africa (HPCSA) and practise as a Specialist Radiologist in South Africa.

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 therefore 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 s/he might due to his/her potential, subjective cognitive knowledge-based and psychological behavioural 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…/

1.2 **COMPETENCE IN RADIOLOGY**

Radiological competence is the 'what' the radiology specialty demands of a candidate specialist ie the requirements to practise 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 South African Qualifications Authority further categorises competence. These definitions are contextualised 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 characterises radiology and its practise

1.4.3 *elective competence* is the competence that equips for potential expansion and development of radiology and its practise 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 a*ttributes* 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 categorisation of competence in radiology serves to demonstrate the multidimensional approach that has been used to describe radiological competence as fully as possible.

2.0 EXIT LEVEL OUTCOMES

The candidate specialist who passes the FC Rad Diag(SA) 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 FC Rad Diag(SA) who, in addition, fulfil the other requirements of all relevant health legislation, may register and practise 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 CMSA in preparation for registration as a Specialist Radiologist in South Africa.

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 maximise 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 procedures.

2.2.5…/

2.2.5 Practise 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 the CMSA) 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 behaviour 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…/

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 Recognise 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…/

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 recognise 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[1]

- The CMSA senate (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 8 years of completing part I. Failure to comply will require that the entire part I examination be repeated.
- 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. MMed Part I Radiology Anatomy and/or Physics can also be carried after appropriate proof has been supplied.

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 HPCSA recognised 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 HPCSA-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 CMSA and returned to the candidate).

4.2.2 Supervisors' approval of the candidate's Portfolio

5.0…/

[1] Change in number attempts requirements

5.0 Format of the examinations:

5.1 **FC Rad Diag(SA) 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 (300 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(SA) Part I**
(See Annexure C)

5.3 **FC Rad Diag(SA) Part II**

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 sixty 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. Seven 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 30 minutes each.

5.4 **Recommended Reading and Electronic Media for FC Rad Diag(SA) Part II**
(See Annexure C)

6.0 Performance in the examinations[2]

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 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.

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

6.6 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 70% subminimum for the Rapid Reporting component to allow entry to the Long Case Reporting and Oral Components.

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

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

6.9…/

[2] Change in number attempts requirements

6.9 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%

6.10 To pass the Part II the following are required:

6.10.1 A 50% subminimum for the Written component is required to allow entry to the Long Case Reporting and Oral components- see 6.7

6.10.2 A 70% subminimum for the Rapid Reporting component is required to allow entry to the Long Case Reporting and oral components

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

6.10.4 A 50% subminimum for over half of the cases in the Long Cases Reporting session (ie at least 50% to be achieved in 4 of a total of 7 cases)

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

6.10.6 An overall total mark of 50% or more

6.10.7 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.

6.10.8 Candidates who achieve the required 50% in the Written component of the examination
AND
The required 70% 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..

7.0 ADMISSION AS A FELLOW

7.1 Only candidates who have completed training in a CMSA recognised registrar post may be awarded a fellowship if successful in the examination.

7.2 **Candidates who have written the examination as a prerequisite from the HPCSA for inclusion on the specialist register are not eligible to be awarded a Fellowship but will be sent a letter confirming their success in the examinations**

All other candidates will be asked to sign a declaration as below:

I, the undersigned, …… do solemnly and sincerely declare

that while a member of the CMSA I will at all times do all within my power to promote the objects of the CMSA and uphold the dignity of the CMSA and its members

that I will observe the provisions of the Memorandum and Articles of Association, By-laws, Regulations and Code of Ethics of the CMSA as in force from time to time

that I will obey every lawful summons issued by order of the Senate of the said CMSA, having no reasonable excuse to the contrary

and I make this solemn declaration faithfully promising to adhere to its terms

Signed at ……..……. this …… day of

…….. 20 ……..

Signature ….…….....……

Witness ……
(who must be a Founder, Associate Founder, Fellow, Member, Diplomate or Commissioner of Oaths)

7.3 A two-thirds majority of members of the CMSA Senate present at the relevant meeting shall be necessary for the award to any candidate of a Fellowship

7.4 A Fellow shall be entitled to the appropriate form of certificate under the seal of the CMSA

7.5 In the event of a candidate not being awarded the Fellowship (after having passed the examination) the examination fee shall be refunded in full excluding HPCSA candidates who are not entitled to a Fellowship.

7.6 The first annual subscription is due one year after registration (statements are rendered annually)

A N N E X U R E A

1.0 Core Curriculum for the FC Rad Diag(SA) Part I

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

- electromagnetic radiation
- wave-particle duality
- electromagnetic spectrum
- energy of photons

1.1.2 Production of x-rays

- 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

- generator types and waveforms: single phase, 3 phase, 6 and 12 pulse, medium frequency, capacitor discharge, battery operated
- effect on radiation output
- effect on image quality
- exposure times
- automatic exposure control

1.1.4 Interactions between x-rays and matter

- coherent scatter
- photoelectric effect and characteristic radiation
- Compton scatter
- 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

- inherent filtration
- added filtration
- K-edge filters
- methods to reduce scatter: collimation, compression, grids, air gaps, compression etc

1.1.6 Luminescent screens

- principles of action
- absorption and conversion efficiency
- 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 eg molybdenum tube and filter
- geometric unsharpness as a limiting factor
- recording system: film screen, digital
- magnification techniques
- alternative breast imaging: radionuclide imaging , US, MR
- principles and applications of stereotaxis
- breast Tomosynthesis and Elastography

1.1.15 **Principles of computers**

- terminology: pixels, matrix, bits, bytes, display levels (bits per pixel), storage technology and requirements
- central processing unit, key board, video display unit
- mass storage devices: tape, CD, DVD, MOD
- input and output devices
- network principles
- working understanding of DICOM standards
- basic and middle computer literacy

1.1.16…/

1.1.16 **Computed tomography**

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

1.1.17 **Computed radiography**

- digital fluoroscopy: pulsed fluoroscopy
- computed radiography
- flat panel detectors
- digital subtraction techniques
- equipment requirements: tube, generator, image intensifier, TV chain, processing
- digital imaging processing
- computer radiography systems [CR]
- direct radiography systems [DR]
- patient archiving and communication systems [PACS]
- radiology information systems [RIS]
- 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
- image quality: signal to noise ratio, spatial resolution, artefacts
- flow effects: flow void, flow imaging
- equipment: magnets, gradient coils, RF coils, computer systems
- magnetic resonance angiography techniques: diffusion, perfusion, functional,
- 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 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, isotopes used in clinical practice

1.1.20…/

1.1.20 **Ultrasound**

- 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
- 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.
- 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**

- 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
- methods to reduce dose to patients
- methods of assessing radiation dose: dosimetry, film badge dosimeters, thermo-luminescent 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 eg universally accepted conventions and/or departmentally tailored/customised protocols, besides those addressed above, that can be directly controlled.

- QA & C in general radiography and fluoroscopy including fluoroscopy in specialised imaging procedures
- QA & C in radionuclide imaging
- QA & C in MR scanning
- QA & C in CT scanning
- QA & C in ultrasound

1.1.24…/

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
- 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 South African 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 multi-detector CT is required.

2.1.4 **Abdomen**

A detailed anatomy of the cross sectional imaging anatomy of the abdomen is required including MR. 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 MR.

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 Performance Portfolio provided by the College of Radiologists of South Africa
- 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 x-ray technique, ultrasound, fluoroscopy, radionuclide imaging, computed tomography, magnetic resonance imaging and positron emission tomography (where available).
- Conventions and protocols where relevant should be emphasised.
- 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 eg intravascular, sub-arachnoid, gastro-intestinal; imaging specific eg ultrasound and MRI
- applications: fluoroscopic, ultrasound and MR imaging
- adverse reactions and their treatment

A N N E X U R E B

1.0 Core Curriculum for the FC Rad Diag(SA) Part II 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 patho-physiology 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 clinico-radiological meetings and discussions, which could finally culminate in credible publications of findings.

A N N E X U R E C

Resource List for FC Rad Diag(SA) 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: 978-0781736756*

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 MeAn 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: 978-0443101632| 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.../

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/radiology-teaching-files.html)
RADPRIMER /STAT DX / RIT-I – recommended but require subscription.

JOHANNESBURG
November 2017