CMS 01 PH	**NATIONAL CURRICULLUM: MEDICAL PHYSICISTS** **MEDICAL AND DENTAL PROFESSIONS BOARD: MEDICAL SCIENCE**

This document describes the National Curriculum for Medical Physicists.
It is important to note the following:

a) *Core curriculum: The minimum prescribed requirements to be successfully completed to pass the Board examination (Portfolio of Evidence).*
b) *Evidence-based: Evidence of ALL components or elements has to be provided.*
c) *Facility-based training program: Every training facility should develop a facility-based training program based on the minimum requirements prescribed in this National Curriculum.*
d) *Assessment of components: All elements or components of the training program MUST be assessed and documentation of mode and frequency of assessment must be prescribed.*

It is important that this document be read in conjunction with document CMS A (Policy regarding training of intern medical scientists) which is applicable to all disciplines within Medical Science.

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National Curriculum Guideline in preparation for registration as a Medical Physicist with the Health Professions Council of South Africa

1. Introduction

The purpose of internship training is to provide an environment for candidates to complete their training under supervision and guidance in accredited training facilities. Internship training should provide opportunities to further develop knowledge, skills, appropriate behaviour patterns and professional thinking, as well as to gain insight, understanding and experience in the health care platform. The primary goal of an internship is to build skill and competency in a clinical environment. Medical Physicists provide an auxiliary and supporting service to medicine which leads to or impacts diagnosis, treatment and consultation with other health care practitioners. They are part of a multidisciplinary health care team and are based in public and private health care facilities and hospitals.

2. Scope of the Practice of a Medical Physicist

The following acts are hereby specified by the board under section 33 as acts which, for the purposes of the Act, shall be deemed to be acts pertaining to the profession of medical physics where such acts, subject to the conditions of Government Notice No. R. 2410 of 18 November 1980, published in terms of the Atomic Energy Act, 1967 (Act No. 90 of 1967), and Government Notice No. R. 1332 of 3 August 1973, published in terms of the Hazardous Substances Act, 1973 (Act No. 15 of 1973), are performed in areas where ionising and non-ionising radiation is used in medical and dental practice.

3. Overview of training

This Training Prospectus is concerned with the training of Intern Medical Physicists. Medical Physics is concerned with the application and development of the principles and techniques of physics to the diagnosis, treatment and prevention of human disease. The diverse range of work carried out within this field, and the evolution of identifiable sub-disciplines within it, require that there is a formal approach to the training of new entrants to the profession. This ensures a proper vocational foundation to their careers.
Rotational time periods spent by the Medical Physics Intern in the different disciplines should be at least 10 months in Radiation Oncology, 6 months in Nuclear Medicine, 3 months in Diagnostic Radiology and 2 months dedicated to Radiation Protection. The minimum total period of internship is 24 months.

4. Criteria for accepting interns for training

The intern must be in possession of a *Medical Physics Honours degree, or an equivalent degree from an accredited education institution.*

5. Overall outcomes

The overall outcome of internship is gaining knowledge, expertise, skills and experience in the integration of academic knowledge, scientific principles and practical methods into the clinical platform. A medical physicist is part of a health care team which will impact the diagnosis and treatment of patients.

At the end of formal training, a medical physicist should have gained knowledge, expertise, skill and a certain degree of experience in the following core competencies:

5.1 Scientific principles (including discipline-specific academic knowledge)

a) demonstrate an understanding of the physics and life sciences relevant to a particular discipline
b) demonstrate basic research skills to be able to identify problems, formulate hypotheses and develop an experimental plan to resolve a problem
c) select and use appropriate measuring equipment
d) recognise fault situations and take appropriate action
e) assess and quantify errors in measurements and procedures
f) Search the literature effectively and critically.

5.2 Clinical (including discipline-specific academic knowledge)

a) demonstrate an understanding of normal physiology and anatomy applicable to radiation medicine
b) demonstrate an understanding of disease processes in areas relevant to the particular discipline
c) demonstrate standards of appearance, personal hygiene and behaviour that engender the trust and respect of patients and clinical colleagues
d) Demonstrate an understanding of medical and professional ethics as it applies to Medical Physics. Study the HPCSA and institutional ethical guidelines, e.g. ethics of dealing with patients and clinicians, and confidentiality
e) Demonstrate an appreciation of the principles of clinical governance.

5.3 Administration, management, accreditation and general Medical Physics services

a) demonstrate an awareness of the functional structure of the organisation in which he/she is employed and his/her place in it
b) demonstrate an understanding of the responsibilities of associated disciplines and the inter-relation between fellow professionals
c) examine the legislative framework of the medical physics discipline, including the relevant Acts, regulations and guidelines e.g. The Hazardous Substances Act, The Health Act and the Health Professions Act, regulations concerning the control of electronic products, etc
d) organise his/her time effectively
e) demonstrate the ability to collect, collate and pass on information efficiently and effectively
f) Appreciate the limitations of his/her knowledge and experience and know when to seek additional guidance.

5.4 Communication Skills

a) communicate effectively with clinical and professional colleagues understanding and practising the principles of confidentiality
b) present material effectively through reports, presentations and seminars
c) discuss appropriately with patients, procedures being undertaken if needed
d) Demonstrate an ability to work within a team.

5.5 Quality and Safety

a) demonstrate an understanding of, and apply the principles and practice of, Health and Safety at work to his/her own activities;
b) demonstrate an understanding of, and apply the principles of, quality assurance to his/her own work;
c) discuss the applicability of quality systems within Medical
d) Carry out a formal risk assessment of a procedure.

5.6 Information and Communications Technology

a) be proficient in the use of word processing, spread sheet and database packages
b) manage filing systems.

5.7 Applicable knowledge and understanding of medico-legal and ethics

a) HPCSA guidelines and ethical rules which cover concepts such as responsibility, accountability, consent, confidentiality and disclosure in terms of professional conduct and patient care including reasonable practice and practicing in good faith
b) The relevant Acts such as the Occupational Health and Safety Act, Compensation for Occupational Injuries and Diseases Act, National Health Act including regulations of the HPCSA, Labour Relations Act, Atomic Energy Act, 1967 (Act No. 90 of 1967), and Government Notice No. R. 1332 of 3 August 1973, published in terms of the Hazardous Substances Act, 1973 (Act No. 15 of 1973).
c) Ethics of dealing with patients (HPCSA ethical rules and facility).
d) Ethics applicable to perform research

5.8 Research methodology (principles and application)

a) Academic discourse
b) Critical review of the literature
c) Defining a research question/hypothesis and developing and presentation of the proposal/protocol
d) Ethics application for a research protocol (through the relevant university and/or provincial ethics committee)
e) Study design
f) Executing the research
g) Data management, analysis and interpretation, critical thinking
h) Presenting research findings through writing up a research report, presentation and formal peer-assessment at a research meeting / academic days / conferences / departmental seminars
i) Basic biostatistics where applicable
j) Application of ethical principles and good clinical practice in the practice of research within an accredited environment
k) Referencing techniques/methods and citation
l) Funding processes and budgeting

6. Discipline-specific competencies and outcomes

Internship is measured or assessed based on the specific outcomes of various components all leading to the overall competency as defined in overall outcomes. These also include:

6.1 Radiotherapy Competencies

The trainee should be able to:

6.1.1 Dosimetry and Quality Control

a) outline the function and characteristics of the main types of equipment used for radiotherapy e.g. treatment units, EPID, ionisation chambers
b) demonstrate an understanding of how machine performance parameters may affect the absolute dose and/or dose distribution to a patient
c) operate therapy equipment safely (under supervision)
d) perform routine calibration and quality control tests for a representative selection of items of equipment used in radiotherapy including implementation of current agreed upon Codes of Practice
e) calibrate a field instrument for photon and electron measurements
f) demonstrate a knowledge of special and advanced techniques such as TBI, IMRT, etc.

6.1.2 Treatment Planning

a) demonstrate an understanding of immobilisation devices and their application (to include mould room experience);
b) acquire anatomical data for planning and definition of target volume;
c) calculate doses at depth for electrons and photons for single, parallel opposed and irregular fields;
d) operate computer systems to produce treatment plans using 2D and 3D photon algorithms in conjunction with both multi-slice CT data sets and simple surface outlines;
e) critically evaluate treatment plans and different methods of compensation;
f) demonstrate an understanding of the choice of energy of photons and electrons for clinical application;
g) calculate monitor units (or treatment time) taking into account field size factors, wedge factors, change of FSD and any other factors in common use;
h) demonstrate a working knowledge of the use of such terms as percentage depth dose, TMR, BSF etc.

6.1.3 Brachytherapy

a) perform treatment time calculations for at least one dosimetry system of Brachytherapy for interstitial and surface implants using HDR and LDR techniques;
b) participate in the procedures for the safe use and custody of the different radioactive sources used in brachytherapy including wipe tests, the action to be taken if a source is lost, and formal disposal.

6.1.4 Quality Assurance and Safety

a) demonstrate an understanding of the safe operation of simulator or other imaging devices including C-arm and CT and treatment units and the use of interlocks on radiotherapy equipment,
b) demonstrate an awareness of environmental dose rates around treatment units and perform dose rate measurements with an appropriate survey meter;
c) discuss the scope, requirements and interpretation of relevant SA legislation, Codes of Practice, Local Rules and guidance and demonstrate an understanding of the practical implementation of local rules within all areas of radiotherapy.

6.2 Diagnostic Radiology Competencies

The trainee should be able to:

6.2.1 Equipment Performance Assessment

a) demonstrate an understanding of the principles of quality assurance as applied to diagnostic imaging systems;
b) operate radiographic and fluoroscopic equipment for the purposes of performance/safety testing (operation of more complex equipment [e.g. CT] may require the assistance of a more experienced operator);
c) perform measurements appropriate to safety testing, commissioning & periodic routine testing of a wide range of diagnostic systems;
d) perform measurements to assess image quality in various types of equipment, to include at least film screen imaging and image intensifier systems;
e) understand the principles of, and performance testing of, digital imaging systems;
f) Analyse results and draw conclusions following these measurements, in particular, regarding equipment options for optimisation.

6.2.2 Patient Dosimetry

a) perform appropriate measurements and/or calculations to assess patient dose for a range of examinations, which must include examples from radiographic, fluoroscopic, CT and mammographic examinations;
b) analyse patient dose measurements and, in the context of optimisation, draw conclusions;
c) assess, by simulation and/or measurement, patient dose reduction interventions;
d) calculate organ dose and Effective Dose and relate dose to risk and effectively communicate the risk.

6.3 Nuclear Medicine Competencies

The trainee should be able to:

6.3.1 Use of Equipment and Clinical Applications

a) describe the operation and function of the main items of equipment used in nuclear medicine including gamma camera, sample counter, radionuclide calibrator;
b) carry out routine operations using this equipment (including data and image acquisition and processing) recognising artefacts in data and images;
c) demonstrate an understanding of the facilities necessary for the production of radiopharmaceuticals;
d) prepare common Tc-99m labelled radiopharmaceuticals using appropriate protocols;
e) describe and demonstrate the salient features of common radionuclide images and tests including their clinical context and uses;
f) demonstrate an understanding of a range of therapeutic procedures with radiopharmaceuticals.

6.3.2 Quality Assurance and Safety

a) perform routine calibration and quality control tests for all major items of equipment and radiopharmaceuticals used in Nuclear Medicine (this should include involvement with SPECT and/or
b) analyse the documentation and results of quality control procedures;
c) identify and apply radiation protection techniques including the use of shielding, distance and time;
d) identify the appropriate action following the occurrence of accidents or incidents and demonstrate decontamination techniques;
e) demonstrate an understanding of the role of clinical and organisational audit in Nuclear Medicine;
f) discuss the scope, requirements and interpretation of relevant SA legislation, Codes of Practice, Local Rules and guidance;
g) demonstrate an understanding of the legal standing and the practical implementation of local rules within all areas of Nuclear Medicine.

6.4 Radiation Protection Competencies

The trainee should be able to:

6.4.1 Use of Equipment

a) outline the operation & function of the main types of equipment used for the production of radiation;
b) use a variety of instruments to measure the physical characteristics of the emitted radiation;
c) Select, use and justify the choice of a detector and methodology for making a range of radiation measurements appropriate to radiation protection of staff and patients.

6.4.2 Radiation Control and Legislation

a) demonstrate an understanding of the effects of radiation and associated risk factors;
b) describe the hazards and the practical staff safety measures and systems of work associated with a range of different uses of radiation;
c) outline the methodology of, and participate in, radiation risk assessments;
d) participate in an audit of local safety arrangements and analyse and draw conclusions from the safety audit;
e) describe Local Rules in the context of the local safety management structure in different radiation environments;
f) perform measurements to assess radiation levels in the environment, including the assessment of staff exposure, and analyse and draw conclusions from these data;
g) perform calculations to assess shielding/safety requirements for a particular radiation hazard and design safe and effective radiation facilities;
h) perform appropriate measurements and/or calculations to assess
i) patient dose for a range of applications and draw conclusions especially concerning the appropriateness of, and the risk from,
j) perform measurements to assess the hazards and demonstrate an understanding of the protection measures available to staff working in radiology departments;
k) perform measurements and calculations appropriate for the safe design of radiological facilities (with emphasis on the selection of suitable building materials);
l) discuss the scope, requirements and interpretation of relevant SA legislation, Codes of Practice, Local Rules and guidance.

6.4.3 Quality Assurance and Safety

Participate in the quality assurance and calibration of radiation measurement equipment.

6.5 Magnetic Resonance Imaging Competencies

The trainee should be able to:

6.5.1 Use of Equipment

a) demonstrate an understanding of the basic role of the major components of an MRI system;
b) select appropriate RF coils and positioning for MRI of test phantoms or subjects;
c) use MRI equipment to obtain images of test objects;
d) select appropriate imaging protocols and/or parameters to produce images using basic pulse sequences;
e) demonstrate an understanding of motion-artefact reduction strategies such as cardiac and respiratory gating and breath- hold imaging;

6.5.2 Clinical Applications

a) demonstrate familiarity with normal and pathological images obtained in common applications using simple pulse sequences;
b) demonstrate understanding of the role of imaging parameters in determining image contrast and the underlying effect of varying these parameters for spin echo and gradient-echo sequences;

6.5.3 Quality Assurance and Safety

a) perform routine test procedures for image quality indices such as signal-to-noise ratio, uniformity and distortion;
b) be aware of the principal instrumental factors affecting image quality;
c) be aware of the principal sources of image artefacts in MRI and of methods for their reduction;
d) be aware of the potential biophysical and practical hazards of MR equipment, including hazards arising from cryogens and in relation to fire protection and other emergency services;
e) demonstrate familiarity with the concept of the MR controlled area and with the administrative controls required to ensure safety in relation to this area.

6.6 Ultrasound Competencies

The trainee should be able to:

6.6.1 Use of Equipment and Clinical Applications

a) describe the operation and function of the major components of an ultrasound scanner, including examples of new technology;
b) use ultrasound equipment to obtain images of test objects;
c) understand the choice of equipment and settings for particular clinical applications;
d) recognise and explain artefacts of imaging and Doppler systems;
e) recognise normal and pathological appearances in common areas of application using grey scale, colour flow, spectral Doppler and M-mode displays.

6.6.2 Quality Control and Safety

a) perform routine calibration and quality assurance tests on ultrasonic imaging systems;
b) discuss quality assurance techniques for Doppler systems;
c) analyse the results of calibration and quality assurance procedures;

6.7 Medical Imaging Competencies

The trainee should be able to:

6.7.1 Use of Equipment and Clinical Applications

a) describe the operation and function of the main items of equipment and acquire images using this equipment for further manipulation and processing;

b) describe the main clinical applications of each imaging modality; MI 2.3 recognise image artefacts;
c) demonstrate familiarity with normal and pathological images
d) obtained in common applications;
e) demonstrate an understanding of the effect of bit depth and pixel size on image contrast and resolution;
f) use various image formats to transmit images between systems e.g. DICOM, interfile, proprietary formats, TIFF, JPEG, VRML
g) perform basic image processing e.g. manipulating colour look-up tables and window settings used to display images, basic image enhancement (edge enhancement, smoothing), filtering in the frequency domain, the Fourier transform, dynamic image processing;
h) Manipulate images using different display techniques e.g. the use of image reconstruction, multi-planar reformatting, 3D visualisation methods.

6.7.2 Quality Control and Safety

a) discuss the principal instrumental factors affecting image quality and undertake routine test procedures to monitor image quality;
b) carry out measurements and test procedures to measure the performance of diagnostic imaging equipment;
c) work safely within controlled areas and demonstrate an awareness of the administrative controls required to ensure safety;
d) use protective clothing and equipment where appropriate

7. CONTINUOUS ASSESSMENT OF TRAINING

7.1 Formal evidence-based continuous assessment must be performed over the 24-month period, with at least annual reports.

7.2 All components of the training program have to be assessed.

7.3 The format of assessment and frequency of assessment have to be clearly indicated.

7.4 This is an evidence-based document and will not be accepted without original signatures and dates of each assessment.

8. ROTATION ROSTER

A schedule or planning roster (over the 24-month period) has to be included in the training program including all the various components of the program (please specify each component) with a period, supervisor and specific laboratory.

9. OUTCOME ASSESSMENT BY PRESCRIBED BOARD-APPOVED COMPETENCY-BASED ASSESSMENT

9.1 A formal assessment process will be conducted to ensure the candidate has acquired the necessary skill / knowledge outlined in the syllabus.

9.2 The assessment is in the form of a Portfolio of Evidence – Refer to Form CMS A.