AFRA

RAF/6/044

STRENGTHENING MEDICAL PHYSICS IN SUPPORT OF CANCER MANAGEMENT - PHASE II

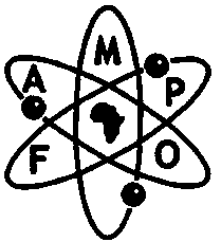
TEMPLATE PORTFOLIO FOR THE REGIONAL CLINICAL TRAINING PROGRAMME IN RADIOTHERAPY MEDICAL PHYSICS

REPORT OF A TASK FORCE MEETING

2013

Recommendations for Medical Physics Education in AFRA Member States

This document is endorsed by the Federation of African Medical Physics Organizations



FOREWORD

This document is a guide for radiotherapy medical physics residents and supervisors to monitor the progress of residents and for residents to provide evidence of having successfully completed a structured clinical training programme. The template portfolio is based on the regional clinical training programme developed for radiotherapy medical physics in 2013 under RAF6/044. Evidence of clinical training is becoming more important in order to satisfy health authorities that an acceptable degree of competence has been attained to practice independently as a clinically qualified medical physicist in a hospital. Clinical training complements the education of medical physicists who have completed a postgraduate academic programme. The regional postgraduate medical physics syllabus for academic programmes was also published in 2013.

This document is also based on terminology and recommendations from the IAEA Technical Course Series No. 37 (2009) [1] and Human Health Series No. 25 [2]. Member States are encouraged to adapt the IAEA guidelines to national conditions and needs when establishing programmes. A task force meeting was convened in Ethiopia under the regional African Radiotherapy Medical Physics project (RAF6/044) in September 2013 in order to develop a template portfolio that could be used to document competencies and monitor progress throughout a structured clinical training programme in radiotherapy medical physics. Regional experts participated in this meeting.

Radiotherapy is multidisciplinary and in addition to scientific knowledge and skills, good clinical practice also requires effective communication with other health professionals, professional ethical behaviour, and applied and critical thinking. Technological advancements in the field of radiation medicine have resulted in the need for diagnostic radiology and nuclear medicine medical physics competencies in radiotherapy medical physics. As a result, clinical training in radiotherapy medical physics will necessarily require some competencies in radiology and nuclear medicine medical physics. Efforts are underway to develop regional clinical training programmes for imaging medical physics.

This document is endorsed by the Federation of African Medical Physics Orgamizations (FAMPO).

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1. INTRODUCTION

Successful completion of a postgraduate academic programme in medical physics leads to partial fulfilment of the requirements to be recognized as a clinically qualified medical physicist (CQMP) [2]. The academic programme needs to be complemented by a structured clinical training programme in order to develop the skills and competencies necessary to practice in the clinical environment. The aim of a supervised hospital-based clinical training programme is to provide a resident (also known as a registrar, intern or trainee) with the opportunity to develop the skills and competencies required to practice independently. Fig. 1 schematically shows the recommended education requirements for recognition as a CQMP. The component circled in red is of reference to this document.

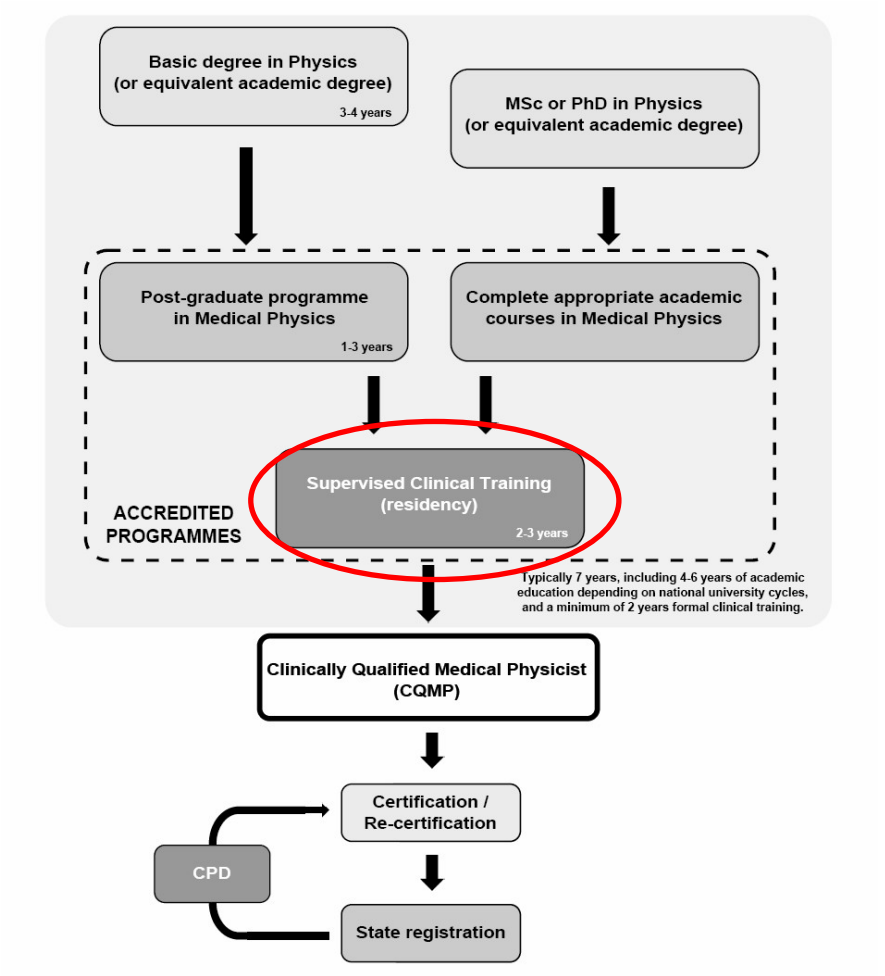

FIG.1. Minimum requirements for the academic education and clinical training of a Clinically Qualified Medical Physicist [2].

In Africa, a 1 year clinical training programme in radiotherapy medical physics is currently recommended, noting that the relevant radiation protection aspects are to be included. In general clinical training programmes do not result in the award of a qualification as they focus on experiential and professional aspects. On completion of an academic programme in medical physics, a student is equipped with the knowledge of medical physics as an applied science in medicine. In order to develop the ability to apply medical physics concepts to the technical, physical, ethical and safety aspects of radiotherapy, skills and competencies need to be acquired through interaction with an established clinical environment. Clinical training therefore needs to be conducted under the direct supervision of CQMPs. Residents have access to patients and their records, but they are not qualified to take any direct responsibility for decision-making related to patient management and care.

National centres, even with limited radiation medicine facilities, can be encouraged to initiate programmes using the resources that are available. This may be limited to partial fulfilment of the recommended programme only, which could be supplemented by national or regional cooperative efforts, in order to develop the comprehensive set of competencies. All programmes, including those leading to partial fulfilment, should be accredited and successful completion of such a programme should result in appropriate recognition by the national responsible authority. Often this recognition process requires documentary proof and confirmation that competencies have been acquired and assessed by an appropriate authority.

Residents should be encouraged to compile and maintain a personal logbook, which is a record of their training experience. A portfolio, which is a formal record of the systematic development of competencies as they are attained by the resident, should be developed. In principle the portfolio itself is evidence of having undergone a clinical training programme. It can also serve as a baseline reference for self-study and lifelong learning.

Competency is not achieved by following checklists or a set of instructions to routinely perform a specific task. Professional competency requires that the resident is continuously engaged in the contribution of medical physics professionals to comprehensive, ethical, safe and effective patient management in radiotherapy according to international guidelines, recommendations, standards and protocols. Ideally continuous evaluation mechanisms should be developed to monitor the resident's progress during the programme and these can include presentation skills, practical demonstrations, documented case studies and appropriate responses to case scenarios. A formal, independent assessment of the resident should take place at least at the end of the training programme.

2. COMPETENCY-BASED TRAINING

The IAEA Interim Basic Safety Standards [3] requires that medical physicists with responsibilities for medical exposures are specialized "in the appropriate area" and as such, "meet the respective requirements for education, training and competence in radiation protection". In addition, "for therapeutic uses of radiation, the requirements of these Standards for calibration, dosimetry and quality assurance, including the acceptance and

commissioning of medical radiological equipment… are fulfilled by or under the supervision of a medical physicist". In order to meet these requirements, an intensive programme of structured learning in an enabling environment is necessary to produce a CQMP. Although a busy clinical environment can often be perceived by residents to offer less individualized opportunities for professional development, the importance of being exposed to a range of cases, techniques and technologies that are appropriate to the regional needs, must be emphasized. As a result, it was not recommended that clinical training is conducted in highly specialized, advanced or emerging technologies, but instead concentrates on providing residents with a thorough grasp of safe and effective evidence-based practice. Accordingly, the portfolio presented here is structured to record the development of medical physics competencies needed for standard of care in the region using current modern technology.

2.1. THE NEED FOR DEVELOPING CLINICAL COMPETENCIES

According to the IAEA Human Health Series No. 25 [2], "...the principal roles and responsibilities of a CQMP working in radiotherapy can be summarized in the first instance, according to those that are common to CQMPs working in other disciplines, i.e. calibration and verification of measurement instruments, technical supervision of equipment operation and maintenance, records and documentation, clinical computing and networking, research and development, and education and training. Additionally, specific roles and responsibilities are related to the practice of medical physics in radiation oncology:

- Installation, design, technical specification, acceptance and commissioning of equipment, including establishment of criteria for acceptable performance
- Radiation safety and protection of patients, staff and the general public,
- Radiation dosimetry of radiation sources and patients
- Optimization of the physical aspects of diagnostic and therapeutic procedures
- Quality management of the physical and technical aspects of radiation medicine, such as:
    - Development of institutional policies and procedures for the safe and effective use of radiation
    - Supervision of quality assurance (QA) programmes and quality control (QC) procedures
    - Risk assessment and management
    - Collaboration with other clinical professionals in patient care, such as:
        - Consultation with medical practitioners and other clinical team members during diagnostic or therapeutic procedures
        - Commissioning and supervision of the implementation of new or complex clinical procedures, and assisting in the training of clinical staff..."

Associated with each of these roles and responsibilities is not only academic knowledge and ability, but also an acquired set of skills and competencies obtained during a structured clinical training programme. The portfolio developed here is based on the regional clinical

training programme recommended for radiotherapy medical physics and addresses each of these roles and responsibilities.

2.2. SUPERVISORY ASPECTS

It was recommended that a practising CQMP with at least 5 years' experience in hospital-based independent practice should supervise the overall programme. A maximum ratio of residents (interns or trainees) to CQMP staff of 2:1 (taking into account the workload of the facility and additional numbers of practising CQMPs) was also recommended. It is the responsibility of the supervisor to ensure that suitably qualified mentors facilitate the clinical training and assist the resident in accomplishing the various facets of the programme.

The clinical supervisor(s) are responsible for ensuring that the resident is trained in all aspects of the nationally-accredited radiation oncology medical physics clinical training programme. This may require that the resident is placed at other institutions (nationally and regionally) to receive the full spectrum of exposure to all modalities, techniques and technologies. The supervisor(s) should meet regularly with the resident to discuss progress (including reviewing deadlines) and to provide adequate supportive and corrective feedback to the resident, such as the level of competency attained and competency achievements which have fallen behind. The resident's clinical training skills, reports and performance should be monitored, reviewed, assessed and documented in the portfolio according to the standards required of the accredited programme.

2.3. RESIDENT LEARNING AGREEMENT

The details of the contractual agreement between the resident, supervisor and the hospital are beyond the scope of this document. Residents often have little or no work experience and enter clinical training programmes immediately following fulltime academic education. As a result, integration into the clinical environment can be intimidating and challenging for a new resident. In addition, most procedures and decisions in clinical environments require ethical consideration. International guidelines which determine the principles of professional conduct, and research and education ethics for medical physicists working in the clinical environment are provided in Appendix I of the IAEA Human Health Series No. 25 [2].

The timely completion of a portfolio requires initiative, time management and motivation which must arise primarily from the resident. Residents need to take initiative to seek out learning opportunities from the clinical environment. Clinical service delivery often takes precedence over the individual expectation of the resident to acquire competencies and a significant proportion of skills development may need to be practiced after-hours.

Difficulty in completing the programme is expected to be encountered when a resident has low initiative and/or is slow to accept responsibility. A specific responsibility of the resident is to meet regularly with the clinical supervisor(s) to discuss progress and to review

deadlines. Important outcomes are the ability to practice independently, take responsibility for decisions and actions, display organizational skills, pay attention to detail, communicate effectively and work within an inter-disciplinary team. With regard to maintaining the portfolio, it is important to ensure that the clinical supervisor(s) “signs off” on satisfactory completion of a competency assessment and that the portfolio is kept up-to-date. Residents should prepare in a thorough manner for all assessments required as part of the programme and take every opportunity to develop knowledge and skills and, once acquired, maintain the knowledge and skills. A culture of lifelong learning should be instilled in residents to encourage their realization of the need for on-going continuing professional development (CPD) as a qualified health professional in order to maintain and update knowledge, skills and competencies.

Clinical training programmes include self-directed study and residents must also take individual responsibility for meeting deadlines. Termination of the clinical training position may be considered if there is a failure to meet the standards required in the programme following a period of supportive and corrective feedback and opportunity to improve. Feedback should be accepted in the spirit that it is provided, i.e. to assist in improving performance.

2.4. TECHNICAL COMPETENCY

A minimum set of equipment was recommended for sites to offer the complete regional clinical training program in radiotherapy medical physics. The portfolio includes technical competencies in all the equipment:

- Positioning/Immobilization systems (breast, head and neck)
- Mould room and workshop equipment
- Conventional/fluoroscopic radiotherapy simulation
- CT-based 3D treatment planning, including access to a computed tomography (CT) scanner
- ^{60}Co teletherapy
- Linear accelerator (LINAC) with photon and electron beams
- Kilovoltage therapy
- Brachytherapy low dose rate (LDR) and/or high dose rate (HDR)
- Access to systems for absolute and relative dosimetry of all treatment equipment.

The assumption is that there is a workload of at least 500 new patients per year, 200 of whom will receive brachytherapy. In addition to the CQMPs, there should be sufficient staffing levels of radiation oncologists and radiation therapy technologists to support the service. At least 15% of the patients should receive individualized CT-based 3D treatment planning.

From the list of equipment it is clear that there is a significant component of radiology procedures (radiographic, fluoroscopic and tomographic) needed for patient imaging as part of the treatment planning and treatment verification process. Some of the competencies gained during training on the physical and technical aspects of these modalities will meet the requirements for some modules of clinical training in radiology and nuclear medicine medical physics. References to the imaging medical physics competencies are noted in the portfolio where applicable.

3. RADIOTHERAPY MEDICAL PHYSICS CLINICAL TRAINING PORTFOLIO

The suggested clinical training portfolio is based on the recommended regional clinical training programme developed in 2013. For the components in which skills and competencies are directly measurable, the modules, sub-modules and activities from the programme are listed in Tables 3.1 - 3.8 and the details of the competencies particular to each activity have been included as a separate column. A column for supervisor comments and signoff is also linked to each competency. The modules are ordered according to the published programme of clinical training but do not necessarily reflect a logical or practical schedule of training. Individual training programmes need to be adapted to the routine clinical activities, departmental workflow and access to equipment at the host institute. The modules included in Tables 3.1 – 3.8 are:

- External beam radiotherapy (EBRT) reference dosimetry including instrumentation and calibration
- EBRT relative dosimetry (acceptance test procedures (ATP), commissioning and ongoing QC)
- Imaging equipment
- EBRT
- Brachytherapy
- Radiation protection and safety
- Equipment specification and acquisition
- Quality management

The procedures listed to support the development of competencies were taken from the IAEA STI/PUB/1296 [4], the IAEA Interim Basic Safety Standards [3], the IAEA Training Course Series No. 37, 47 and 50 [1, 5, 6] and the IAEA Technical Report Series Nos. 277, 398, 430 and 457 [7-10].

The first module of the clinical training syllabus named *Clinical environment in radiotherapy (TCS No. 37 Sub-modules 1.2, 1.4, 7.2)* has not been listed separately as it requires the consolidation of all tasks and activities in order for the resident to fully understand the role and responsibilities of the medical physicist in the inter-disciplinary team. A CQMP must have the ability to be fully conversant with peers and other health care professionals when discussing details of patient care. Such competence will be developed subtly with regular

exposure to inter-disciplinary meetings and participation in quality assurance meetings in which the clinical aspects of patient management are discussed and reviewed.

It should also be noted that the required competencies and behavioural skills to be attained in the 10th module of the clinical training syllabus (*Professional ethics (TCS No. 37 Sub-modules 7.1, 8.1))* are based on national guidelines, regulations and codes of conduct related to the clinical and research environments dealing with human subjects. These can vary widely between countries and the competencies associated with this module need to be adapted accordingly. Although there are several international guidelines that determine professional and research ethics, these are often interpreted and applied differently and therefore harmonized regional guidelines to develop these behavioural skills are not possible. Supervisors will need to inform residents of all ethical principles that are applied to medical physics practice in the host institute in which the training takes place.

The Radiation protection and safety, Quality management and Professional ethics modules have significant overlap with medical physics clinical training programmes in radiology [5] and nuclear medicine [6]. The radiation safety aspects of therapeutic procedures using unsealed ^{131}I or other sources are listed as an activity as this is often the responsibility of the radiotherapy CQMP, especially in low and middle income countries.

It is highly desirable that medical physics residents maintain a logbook of their clinical training experience. This document can be used to develop a portfolio according to the clinical training programme required by their national responsible authority and agreed to by their supervisor(s).

Where there is a lack of clear policy guiding the evaluation of clinical training and subsequent recognition of CQMPs, it is highly recommended that Member States:

- adapt these clinical training guidelines for radiotherapy medical physicists according to their national needs and
- endorse the submission of a portfolio, such as that shown in Tables 3.1 – 3.8, as evidence of having achieved the competencies that are required for independent practice as a CQMP.

TABLE 3.1: PORTFOLIO FOR THE MODULE: EBRT Reference dosimetry including instrumentation and calibration (TCS No. 37 Sub-modules 3.1, 3.2, 3.3, 3.7) FROM THE REGIONAL CLINICAL TRAINING PROGRAMME FOR RADIOTHERAPY MEDICAL PHYSICS RESIDENTS. THE SUGGESTED DURATION FOR THIS MODULE IS 5 WEEKS.

SUB-MODULE	ACTIVITY	PROCEDURES TO ACHIEVE COMPETENCY	COMMENTS, SIGNATURE AND DATE OF SUPERVISOR
kilovoltage therapy	Instrument quality control (QC), calibration and cross calibration of field dosimetry systems	Selection criteria for type of ionization chamber Demonstrate a familiarity with QA recommendations for radiation dosimetry equipment such as: o Electrometer o thermometer o barometer o phantom Check the traceability to a PSDL for a calibration factor used for absolute dose determination Demonstrate a familiarity with the method to express uncertainties in dose measurement	
	Beam quality	Perform measurement and establish the HVL for a low and medium energy X ray beam according to an International Code of Practice	
	Output calibration	Influence effects on the measured quantity (air density, recombination, polarity, warm-up, stem effects, leakage, humidity) Timer effect. Application of an International Code of Practice, e.g. TRS-277 [7] and TRS-398 [8].	
^{60}Co teletherapy	Instrument QC, calibration and cross calibration of field dosimetry systems	Selection criteria for type of ionization chamber Demonstrate a familiarity with QA recommendations for radiation dosimetry equipment such as: o Electrometer o thermometer	

SUB-MODULE	ACTIVITY	PROCEDURES TO ACHIEVE COMPETENCY	COMMENTS, SIGNATURE AND DATE OF SUPERVISOR
		o barometer o phantom Check the traceability to a Primary Standards Dosimetry Laboratory (PSDL) for a calibration factor used for absolute dose determination Demonstrate a familiarity with the method to express uncertainties in dose measurement Perform cross calibrations of reference and field dosimetry systems	
	Reference field mechanical QC	Isocenter Localizing lasers Optical distance indicator (ODI) Coincidence of light and radiation fields Field size indicator (collimator setting) Gantry and collimator angle indicator Cross-hair centring Jaw symmetry	
	Reference dose calibration	Influence effects on the measured quantity (air density, recombination, polarity, warm-up, stem effects, leakage, humidity) Application of an International Code of Practice, e.g. TRS-398 [8].	
	Other calibration methods	Awareness of other Codes of Practice Other setups (SSD/SAD)	
	Constancy – source position, timer, transit time	Develop, document and perform QC for constancy checks based on institutional guidelines and international recommendations	
MV photons (LINAC)	Instrument QC, calibration and	Selection criteria for type of ionization chamber	

SUB-MODULE	ACTIVITY	PROCEDURES TO ACHIEVE COMPETENCY	COMMENTS, SIGNATURE AND DATE OF SUPERVISOR
	cross calibration of field dosimetry systems	Demonstrate a familiarity with QA recommendations for radiation dosimetry equipment such as: o Electrometer o thermometer o barometer o phantom Check the traceability to a PSDL for a calibration factor used for absolute dose determination Demonstrate a familiarity with the method to express uncertainties in dose measurement	
	Reference field mechanical QC	Isocenter Localizing lasers Optical distance indicator (ODI) Coincidence of light and radiation fields Field size indicator (collimator setting) Gantry and collimator angle indicator Cross-hair centring Jaw symmetry	
	Beam quality	Selection criteria for type of ionization chamber Perform a relative ionisation measurement Determination of beam quality according to an International Code of Practice, e.g. TRS-398 [8].	
	Reference dose calibration	Influence effects on the measured quantity (air density, recombination, polarity, warm-up, stem effects, leakage, humidity) Application of an International Code of Practice. Other setups (SSD/SAD)	
	Constancy measurements	Develop, document and perform QC for constancy checks	

SUB-MODULE	ACTIVITY	PROCEDURES TO ACHIEVE COMPETENCY	COMMENTS, SIGNATURE AND DATE OF SUPERVISOR
		based on institutional guidelines and international recommendations	
MeV electrons (LINAC)	Instrument QC, calibration and cross calibration	Selection criteria for type of ionization chamber Demonstrate a familiarity with QA recommendations for radiation dosimetry equipment such as: o Electrometer o thermometer o barometer o phantom Check the traceability to a PSDL for a calibration factor used for absolute dose determination Demonstrate a familiarity with the method to express uncertainties in dose measurement Perform cross calibration, e.g. TRS-398 [8].	
	Beam quality	Selection criteria for type of ionization chamber Perform a measurement of relative depth ionization Conversion to depth dose Determination of beam quality according to an International Code of Practice	
	Reference dose calibration	Influence effects on the measured quantity (air density, recombination, polarity, warm-up, stem effects, leakage, humidity) Application of an International Code of Practice, e.g. TRS-398 [8].	
	Constancy measurements	Develop, document and perform QC for constancy checks based on institutional guidelines and international recommendations	

TABLE 3.2: PORTFOLIO FOR THE MODULE: EBRT Relative dosimetry (ATP, commissioning and on-going QC) (TCS No. 37 Sub-modules 2.4, 3.4, 4.3, 4.4, 4.5) FROM THE REGIONAL CLINICAL TRAINING PROGRAMME FOR RADIOTHERAPY MEDICAL PHYSICS RESIDENTS. THE SUGGESTED DURATION FOR THIS MODULE IS 8 WEEKS.

SUB-MODULE	ACTIVITY	PROCEDURES TO ACHIEVE COMPETENCY	COMMENTS, SIGNATURE AND DATE OF SUPERVISOR
Kilovoltage therapy	Measurement of field size factors, BSF, PDD, ISL, etc.	Measure and produce time chart including time calculation instructions for all applicators. Compare data against a beam library, e.g. British Journal of Radiology, Supplement No. 25 [11]	
	Mechanical, dosimetry and safety checks	Audiovisual monitors Interlocks and warnings Mechanical fixtures Filter interlocks Monitor/timer linearity Focal spot test	
^{60}Co teletherapy	Safety, emergency procedures and Mechanical	Safety interlock Radiation room monitor Audiovisual monitors Emergency off switches Localizing lasers Optical distance indicator (ODI) Backpointer Coincidence of light and radiation fields Field size indicator (collimator setting) Gantry and collimator angle indicator Couch movements	

SUB-MODULE	ACTIVITY	PROCEDURES TO ACHIEVE COMPETENCY	COMMENTS, SIGNATURE AND DATE OF SUPERVISOR
		Cross-hair centring, Jaw symmetry Isocentre Latching of wedges and trays Source positioning	
	Relative Dosimetry measurements: TAR, BSF PDD Open and wedge field data Penumbra Equivalent square	Output constancy traceable to SSDL Field size dependence of output constancy Transmission factor constancy for all standard accessories Wedge transmission factor constancy Timer linearity and error Output constancy versus gantry angle Beam uniformity versus gantry angle Off-axis point measurements with and without wedges Ability to measure and produce a treatment time chart (clinical tables) Compare data against a beam library, e.g. British Journal of Radiology, Supplement No. 25 [11]	
MV photons (LINAC)	Safety Mechanical	Safety interlock Radiation room monitor Audiovisual monitors Emergency off switches Localizing lasers Optical distance indicator (ODI) Backpointer Coincidence of light and radiation fields Field size indicator (collimator setting) Gantry and collimator angle indicator Couch movements Cross-hair centring	

SUB-MODULE	ACTIVITY	PROCEDURES TO ACHIEVE COMPETENCY	COMMENTS, SIGNATURE AND DATE OF SUPERVISOR
		Isocentre Latching of wedges and trays Jaw symmetry	
	Relative dosimetry measurements: Scatter correction factors TMR PDD Penumbra Uniformity and symmetry Open field and wedge data Asymmetric collimation	Demonstrate an understanding of the appropriate use of dosimeters for relative dose measurements Demonstrate an understanding of factors influencing a dose measurement under non-reference conditions Determine the following items in a water phantom: o Percentage depth dose o Beam profiles o TAR, TPR, TMR, etc. o scatter factors (collimator scatter factor, phantom scatter factor) o Penumbra o Uniformity, symmetry and flatness o Open field and wedge data	
MeV electrons (LINAC)	Safety Mechanical	In addition to MV photon safety and mechanical checks: Applicator interlock Applicator position Jaw position for each applicator & energy	
	Relative dosimetry measurements: Applicator factors PDD Irregular fields Uniformity and symmetry Virtual source position	Determine the following items in a water phantom: o Percentage depth ionization o Beam profiles o applicator factors and cutout factors o Penumbra o Uniformity, symmetry and flatness Determine the Virtual source position for different electron energies and field sizes	

TABLE 3.3: PORTFOLIO FOR THE MODULE: Imaging equipment (TCS No. 37 Sub-modules 4.1, 4.3, 4.5, 5.4; TCS No. 47 Sub-modules 5.2 and 5.5) FROM THE REGIONAL CLINICAL TRAINING PROGRAMME FOR RADIOTHERAPY MEDICAL PHYSICS RESIDENTS. THE SUGGESTED DURATION FOR THIS MODULE IS 3 WEEKS.

SUB-MODULE	ACTIVITY	PROCEDURES TO ACHIEVE COMPETENCY	COMMENTS, SIGNATURE AND DATE OF SUPERVISOR
Fluoroscopic simulator	QC and dose (mechanical, safety, radiography, fluoroscopy)	Safety interlock Radiation room monitor Audiovisual monitors (if applicable) Emergency off switches Localizing lasers ODI Field defining wires Gantry/collimator angle indicators Cross-hair centring Focal spot-axis indicator Fluoroscopic image quality Emergency/collision avoidance Coincidence of light and radiation fields Collimator rotation isocentre Gantry rotation isocentre Couch rotation isocentre Coincidence of collimator, gantry, couch axes and isocentre Table top sag with mass evenly distributed Vertical travel of couch Automatic exposure control (AEC); incident air kerma and entrance surface air kerms rate Table top exposure with fluoroscopy	

SUB-MODULE	ACTIVITY	PROCEDURES TO ACHIEVE COMPETENCY	COMMENTS, SIGNATURE AND DATE OF SUPERVISOR
		kVp and mAs calibration High and low contrast resolutions	
C-arm	QC and dose (mechanical, safety, radiography, fluoroscopy)	Audiovisual monitors (if applicable) Emergency off switches Fluoroscopic image quality AEC calibration; incident air kerma and entrance surface air kerma rate, e.g. TRS-457 [10]. kVp and mAs calibration High and low contrast resolution	
Computed Tomography (CT)	QC and CTDI, e.g. TRS-457 [10]	Audiovisual monitors (if applicable) Emergency off switches Uniformity, contrast, noise, & resolution CT slice thickness CT number accuracy, constancy, linearity and uniformity CTDI Couch movement and alignment Laser positioning Distance rendering (table feed)	
	Site-specific and individualised imaging protocols for TP: Scan parameters, scan lengths w.r.t. volume definition, positioning, accessories, contrast agents, artefacts	Ability to suggest imaging protocols based on the request for CT-based treatment planning incl. patient geometry/orientation/positioning/breath-hold or other patient preparation (contrast), slice thickness/length/spacing, scan parameters, gantry tilt and volume definition Be able to distinguish typical image artefacts Check the RTP link between CT and TPS	
Film processor (if applicable)	QC	Measurement and assessment of the processor: Developer temperature Sensitometry, characteristic curves, contrast, base-plus-fog level	

SUB-MODULE	ACTIVITY	PROCEDURES TO ACHIEVE COMPETENCY	COMMENTS, SIGNATURE AND DATE OF SUPERVISOR
		Measurement of chemical replenishment rates Residual fixer (sodium thiosulphate) Artefact assessment Establish and maintain effective processor QC program Quality control charts, plotting, analysis, control limits Replenishment rates Darkroom tests: Visual inspection for light leakage and safelight conditions Assessment of film fog for darkroom light leakage and safelight conditions Carry out performance testing on X ray film, X ray film cassettes and X ray film display devices	
Laser printer/imager (alternative to wet system, if applicable)	QC	Measurement and assessment of: ° EI calibration ° EI consistency ° Latent Decay Time (CR only) ° Linearity of dose and DDI ° Erasure thoroughness (CR only) ° Dark noise ° Image uniformity ° Limiting resolution and MTF ° Noise and low contrast ° Scaling errors and spatial accuracy ° Blurring ° Moire effects ° Plate throughput	

SUB-MODULE	ACTIVITY	PROCEDURES TO ACHIEVE COMPETENCY	COMMENTS, SIGNATURE AND DATE OF SUPERVISOR
		Familiarity with Image measurement tools: ° contrast-detail phantom ° QC phantom	

TABLE 3.4: PORTFOLIO FOR THE MODULE: EBRT (TCS No. 37 Sub-modules 3.5, 3.6, 4.7, 4.8, 5.2, 5.3, 5.5) FROM THE REGIONAL CLINICAL TRAINING PROGRAMME FOR RADIOTHERAPY MEDICAL PHYSICS RESIDENTS. THE SUGGESTED DURATION FOR THIS MODULE IS 12 WEEKS. AN ADDITIONAL 4 WEEKS IS RECOMMENDED FOR THE SUB-MODULE ON 3D COMPUTERIZED TREATMENT PLANNING.

SUB-MODULE	ACTIVITY	PROCEDURES TO ACHIEVE COMPETENCY	COMMENTS, SIGNATURE AND DATE OF SUPERVISOR
Positioning and Immobilization	Observe methods of patient positioning and immobilization in order to facilitate optimal field arrangement and minimize setup uncertainty	Demonstrate an understanding of the purpose of and observe: o Basic patient set-up and movement tracking systems o The manufacturing and use of immobilization devices o An immobilized patient from mould room to treatment machine o Imaging systems for patient positioning from simulation to treatment verification o Simulator to verify plans before treatment o Various methods of port film/EPID evaluation to assess patient positioning accuracy and precision. o Lasers from real/virtual simulation to treatment. o Verification of patient positioning with non-coplanar fields	
Beam modification and shaping devices	Manufacture	Demonstrate an understanding of the advantages of and observe the use of the following beam modifiers: ° Beam shaping devices (blocks) ° Wedge filters ° Bolus ° Compensators	
	QC and verification	Measure transmission factors Measure data for block cutter Check block shape with light and radiation fields	

SUB-MODULE	ACTIVITY	PROCEDURES TO ACHIEVE COMPETENCY	COMMENTS, SIGNATURE AND DATE OF SUPERVISOR
		Check wedge orientation insert	
	Safety aspects	Observe the Good Laboratory Practice (GLP) Conform to and understand mould room safety instructions	
Contours (manual or single slice) and hand-planning	Clinical examples	Perform a Case study with hand-planning	
Techniques relying on a clinical mark-up, a direct setup and 2D simulation	Develop technique, setup instruction and calculation of times	Perform manually a treatment plan with different techniques	
	Clinical examples	Perform a Case study	
Establishing margins for PTV definition	Clinical examples for different sites and techniques	Application of the International Commission on Radiation Units and Measurements (ICRU) concepts in contouring: o Target volumes o Normal organs at risk o Treatment margins Contouring of target volumes and critical tissue structures of interest Collect and analyse data for case studies Determine CTV-PTV Treatment margins needed for contouring the target volumes and organs at risk for a variety of treatment sites	
3D Computerized Treatment Planning System (TPS) equipment	Acceptance Acquisition of beam data Commissioning – geometric, dosimetry and networking CT validation End to end testing	Demonstrate an understanding of: ° The treatment planning process ° The potential sources and magnitude of errors associated with: o Patient data o Beam data o Manual and computer dosimetry calculation algorithms	

SUB-MODULE	ACTIVITY	PROCEDURES TO ACHIEVE COMPETENCY	COMMENTS, SIGNATURE AND DATE OF SUPERVISOR
	Algorithms, e.g. TRS-430 [9]	o Non dosimetric tests (rendering geometric parameters…) Treatment planning equipment ° The operation, functionality, performance specification and inventory items of a TP system ° Merits and limitations of the range of dose calculation algorithms ° The principles and design of a treatment planning QA programme Design the protocols of a QA programme for a treatment planning computer based on the recommendations as specified in IAEA Technical Report Series No. 430 [9] or an equivalent international recommendation as adopted by the department, including: ° Acceptance testing against equipment specification, including: □ Inventory check □ Functionality test of hardware and software □ Geometric and dosimetric accuracy □ Network integration and data transfer ° Commissioning for photon and electron beam planning, including: □ Configuration of: □ Computer system □ Patient demographic data □ Security and backup system □ Treatment machine □ Beam data required, including transfer/input of measured beam data into computer system □ Calculation parameters	

SUB-MODULE	ACTIVITY	PROCEDURES TO ACHIEVE COMPETENCY	COMMENTS, SIGNATURE AND DATE OF SUPERVISOR
		□ Treatment plan report □ Record and archival □ Calibration □ Display and output format □ Verification against measurements and/or independent methods of: □ Image registration and contouring tools □ CT density □ Beam data transferred from acquisition system □ Beam models in standard and extreme conditions □ Dosimetry calculations, including MU calculations □ Treatment plans, including: □ Dose □ Dose distribution □ DVH □ Anatomical geometry □ Beam geometry □ Inhomogeneity correction □ Plan output and transfer ° Quality control of: □ TPS □ Input and output devices □ Backup system □ Beam data □ Patient and image data □ Body and organ contouring □ Dose calculation tools □ Individual patient plan	

SUB-MODULE	ACTIVITY	PROCEDURES TO ACHIEVE COMPETENCY	COMMENTS, SIGNATURE AND DATE OF SUPERVISOR
		□ Computer network • Identify and recommend: ° QC test and measurement equipment required ° Tolerance limits and action levels for each QC test • Develop and prepare worksheets for the tests and measurements • Using the established protocols and worksheets, perform: o Acceptance testing o Commissioning o Quality control • Report any deviations or functional abnormalities and propose corrective actions • Review and update QA protocols and procedures on a regular basis • Prepare: ° Acceptance test report and recommendation ° Commissioning report ° QC report ° Planning data manual	
3D TPS cases	ICRU Volume definition and application of QUANTEC [12] Dose plan modelling process DP evaluation and approval (DVH and prescription) DP verification Setup instruction Generate DRRs	Perform, evaluate and verify several different cases using 3D CT-based treatment planning. Compare different techniques and field arrangements for a range of different disease sites (the disease sites that are typical of the sub-region must be included here). Prepare instructions for setting up a treatment plan based on reference marks and anatomical landmarks. Ability to present a treatment plan. Generate DRRs and check against verification and/or portal	

SUB-MODULE	ACTIVITY	PROCEDURES TO ACHIEVE COMPETENCY	COMMENTS, SIGNATURE AND DATE OF SUPERVISOR
	Shielding and accessories (+QC) Data transfer	images. Manufacture and verify field accessories, e.g. shielding blocks, compensators, bolus, etc. Validate data transfer between systems.	
Treatment delivery	In-vivo dosimetry (IVD)	Review and improve/implement an in-vivo dosimetry programme in line with national and international best practice. Undertake a literature review on the advantages and disadvantages of an in-vivo dosimetry programme and choice of dosimeter. Demonstrate an understanding of advantages and disadvantages of different methods Perform calibration procedure (including the determination of correction factors) Perform in-vivo dosimetry measurements (including writing a case study report) for such examples as: o lens of the eye o in field measurements for • orthovoltage X ray beams • megavoltage X ray beams • electron beams	
	Portal imaging : calibrate, transfer images, compare and evaluate images, QC	Demonstrate an understanding of the operation of the EPID Explain discrepancies between portal images, simulator verification images and DRRs Perform QC on the EPID.	
	Recording and reporting	Demonstrate the advantages of recording and reporting dose volumes according to international recommendations. Perform a case study	

TABLE 3.5: PORTFOLIO FOR THE MODULE: Brachytherapy (TCS No. 37 Sub-modules 2.4, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8) FROM THE REGIONAL CLINICAL TRAINING PROGRAMME FOR RADIOTHERAPY MEDICAL PHYSICS RESIDENTS. THE SUGGESTED DURATION FOR THIS MODULE IS 4 WEEKS.

SUB-MODULE	ACTIVITY	PROCEDURES TO ACHIEVE COMPETENCY	COMMENTS, SIGNATURE AND DATE OF SUPERVISOR
Low dose rate and/or high dose rate (HDR) brachytherapy	ATP	Demonstrate an understanding of the: ° Concept and principles of a brachytherapy QA programme ° Local legislative requirements and international recommendations on safety of brachytherapy and remote afterloading equipment ° Properties and characteristics of the brachytherapy sources ° Specification, quality standard and operation characteristics of: • Brachytherapy sources • Treatment applicators • Afterloading brachytherapy equipment, including LDR, HDR, PDR ° Specification, functionality and dosimetry algorithm of brachytherapy treatment planning computer ° Sources and magnitude of errors associated with: • Manual and afterloading brachytherapy • Brachytherapy treatment planning computer • Dosimetric data of radioactive sources ° Methods and procedures for testing of: □ Remote afterloading brachytherapy equipment □ Brachytherapy source □ Treatment planning computer	

SUB-MODULE	ACTIVITY	PROCEDURES TO ACHIEVE COMPETENCY	COMMENTS, SIGNATURE AND DATE OF SUPERVISOR
		° Use of test and measurement equipment required for acceptance testing ° Tolerance limits for each acceptance test • Develop and prepare test and measurement protocols and worksheets • Using established protocols and worksheets, perform acceptance testing of: ° Brachytherapy source ° Afterloading treatment equipment • Prepare and/or review acceptance test report and recommendations	
	Commissioning	Demonstrate an understanding of the: ° Operation and characteristics of brachytherapy services and equipment ° Performance assessment and testing of brachytherapy equipment and accessories ° Methods and procedures for commissioning of: Remote afterloading brachytherapy equipment Brachytherapy source Treatment planning computer ° Use of test and measurement equipment required for commissioning procedures • Design methods, procedures and work programme for commissioning of a remote afterloader system and treatment planning system, including: ° Configuration of the: Treatment planning computer system, including: Patient demographic data	

SUB-MODULE	ACTIVITY	PROCEDURES TO ACHIEVE COMPETENCY	COMMENTS, SIGNATURE AND DATE OF SUPERVISOR
		□ Security and backup system □ Brachytherapy source data □ Calculation parameters □ Treatment plan report format □ Record and archival □ Export of treatment data • Remote afterloading treatment machine, including: □ Treatment control □ In-vivo dose monitoring system □ Security and backup system □ Import of treatment data □ Treatment record ° Verification against measurements and/or independent methods of: □ Treatment planning computer system, including: □ Image registration tools □ Integrity of input devices, including the digitizer □ Treatment planning, including: □ Dose □ Dose distribution □ DVH □ Source geometry □ Treatment time calculations □ Correction for: ° Decay ° Attenuation □ Treatment plan output and transfer	

SUB-MODULE	ACTIVITY	PROCEDURES TO ACHIEVE COMPETENCY	COMMENTS, SIGNATURE AND DATE OF SUPERVISOR
		□ Afterloading treatment machine, including: □ Integrity of: ° Data transfer from treatment planning system ° Source transfer through the applicators and catheters □ Accuracy of: ° Source positioning ° Dwell time □ Multichannel applicator indexing system □ Treatment and safety features and interlock systems, including: ° Applicator, catheters, and connectors ° Treatment termination ° Door ° Radiation warning indication systems ° Video monitoring system ° Backup power system ° Automatic source retraction system • Prepare test and measurement protocols and worksheets • Perform commissioning of a: ° Remote afterloading treatment system ° Treatment planning computer system • Establishing baseline values for subsequent QC tests • Prepare and/or review commissioning report and documentation • Prepare/review operational procedures for treatment delivery	
	QC	Demonstrate an understanding of the:	

SUB-MODULE	ACTIVITY	PROCEDURES TO ACHIEVE COMPETENCY	COMMENTS, SIGNATURE AND DATE OF SUPERVISOR
		° Operation characteristics and functionalities of brachytherapy equipment and sources ° Acceptance testing and commissioning of brachytherapy equipment and sources ° Sources and magnitude of errors in brachytherapy ° Methods and procedures for QC in brachytherapy ° Equipment required for QC measures ° Tolerance limits and action levels Design a series of QC measures for brachytherapy covering: ° Quality control of: □ Treatment planning system □ Input and output devices □ Patient and image data □ Treatment dose and time calculation tools □ Computer network □ Individual patient plan □ Integrity of radiation sources and their applicators □ Afterloading treatment system: □ Safety and interlock □ Power failure backup systems □ Integrity of: ° Treatment applicators ° Connectors ° Multichannel indexing system ° Source transfer □ Source position and dwell time accuracy □ Dose monitoring system	

SUB-MODULE	ACTIVITY	PROCEDURES TO ACHIEVE COMPETENCY	COMMENTS, SIGNATURE AND DATE OF SUPERVISOR
		□ Data transfer □ Treatment delivery, monitoring of: □ Applicators/source position □ Critical organ dose Develop and prepare QC test and measurement protocols and worksheets Perform QC on a: ° Remote afterloading treatment system ° Brachytherapy treatment planning system ° Brachytherapy source ° Brachytherapy treatment ° Dosimetry equipment Prepare and/or review QC reports and documentation	
	Source calibration and exchange	Demonstrate an understanding of the: ° Dosimetry properties of brachytherapy sources ° Dosimetry protocols for calibration of brachytherapy sources, including the procedures and recommendations ° Properties and functionalities of the calibration equipment ° Uncertainties involved in determination of source strength by measurement and calculation methods Design calibration worksheet Calibrate the strength of a variety of brachytherapy sources using: ° Well-type ionization chamber ° Thimble ionization chamber Compare source strength as given in vendor certificate with	

SUB-MODULE	ACTIVITY	PROCEDURES TO ACHIEVE COMPETENCY	COMMENTS, SIGNATURE AND DATE OF SUPERVISOR
		measurement. Demonstrate an understanding of remedial action if exceeds tolerance level. Prepare: ° Source data for treatment planning ° Calibration report	
	Image, applicator and source data for treatment planning	Demonstrate an understanding of the methods and procedures for: ° Localization and reconstruction of brachytherapy sources ° Acquisition of the relevant patient anatomical information and source (using dummy sources) geometry for treatment planning using: □ Radiotherapy treatment simulator □ Mobile C-arm X ray unit □ CT scanner □ MRI □ Ultrasound scanner ° Measurement of dose and dose distribution of sources Supervise/advice on the acquisition of patient image/data for treatment planning using X-ray, CT, and/or ultrasound for: ° Fractionated or permanent interstitial implant treatment for a variety of sites. Perform for a variety of treatment sites: ° Transfer of image data to the treatment planning system ° Reconstruction of source geometry at the treatment planning computer from:	

SUB-MODULE	ACTIVITY	PROCEDURES TO ACHIEVE COMPETENCY	COMMENTS, SIGNATURE AND DATE OF SUPERVISOR
		□ Orthogonal or stereo-shift X ray film via digitizer □ CT, MR and/or ultrasound images ° Image registration using treatment planning system ° Contouring of treatment volume and critical structures of interest	
	Prescriptions	Demonstrate an understanding of the ICRU Reports	
	Treatment planning	Perform manual dose calculations in brachytherapy use a treatment planning computer to generate an acceptable treatment plan: interstitial, intracavitary, intraluminal, surface mould… Perform QC of individual treatment plans	
	Source preparation	Apply the Good Laboratory Practice (GLP) Demonstrate an understanding of: ° Operation of a radiation source inventory and custody system ° System of work in a sealed source preparation room ° Principles and design of treatment applicators ° Procedures for safe handling and preparation of brachytherapy sources ° Source loading configurations for a variety of treatment protocols	
Safety of sources	Stock, acquire, transport, waste management	Demonstrate an understanding of the management of radiation sources, including: ° Acquisition ° Custody ° Disposal and the handling of records and documentation	
	Emergency procedures	Demonstrate an understanding of the international guidelines	

SUB-MODULE	ACTIVITY	PROCEDURES TO ACHIEVE COMPETENCY	COMMENTS, SIGNATURE AND DATE OF SUPERVISOR
HDR	Optimization methods	Perform Dose/plan optimization based on a combination of: □ Dose prescription/specification □ Source configuration/distribution □ Dwell time	
	Intraluminal techniques	Perform a Case study	
Brachytherapy cases		Perform Case studies	
Treatment delivery	IVD	Calibrate, interpret result	
	Recording and reporting	Demonstrate an understanding of the recording and reporting of dose according to international guidelines and reports.	
Ophthalmic applicators (planar and concave)	QC	Good Laboratory Practice in the handling and safe-keeping of ophthalmic beta-sources. Constancy in output, uniformity.	

TABLE 3.6: PORTFOLIO FOR THE MODULE: Radiation protection and safety (TCS No. 37 Sub-modules 2.1, 2.2, 2.3, 2.5, 2.6, 2.7, 2.8, 2.9; BSS Interim Edition Requirement 40 and TCS No. 50 Sub-module 8.3) FROM THE REGIONAL CLINICAL TRAINING PROGRAMME FOR RADIOTHERAPY MEDICAL PHYSICS RESIDENTS. THE SUGGESTED DURATION FOR THIS MODULE IS 4 WEEKS.

SUB-MODULE	ACTIVITY	PROCEDURES TO ACHIEVE COMPETENCY	COMMENTS, SIGNATURE AND DATE OF SUPERVISOR
Design of a facility	Hypothetical exercise : Integration of siting, surrounding structures, infrastructure assessment, expansion needs, workflow and efficiency	Demonstrate an understanding on the: o Local legislative requirements on radiation safety and protection o International standards and recommendations o Nature of source and equipment to be installed o Nature and types of the treatment services to be provided o Source strengths to be used o Projected patient load o Room layout requirements taking into consideration the requirements for sterility, patient flow, work flow, ergonomics and supply logistics Perform radiation risk assessment on the facility	
Shielding calculations for all radiation bunkers	Use layouts to calculate the effective dose rates to the public and the staff around and in the facility	Determine the: o Radiation shielding requirements taking into consideration: − Room layout − Types of treatments to be performed − Projected patient load − Types and activities of the sources	

SUB-MODULE	ACTIVITY	PROCEDURES TO ACHIEVE COMPETENCY	COMMENTS, SIGNATURE AND DATE OF SUPERVISOR
		− Occupancy factors o Appropriate shielding materials for: − Door/entrance − Walls − Ceiling − Floor o Required thickness for the shielding structures o Radiation warning signs and signals o Ancillary and accessory safety equipment, including: − Radiation monitoring and alarm system − Door interlock − Closed circuit television o Safety interlock system Calculate the radiation dose levels for: o Areas of interest o Staff o Other personnel Prepare reports and documentation	
	Verifying shielding calculations using survey instruments	Conduct radiation survey and monitoring Assess results, draw conclusion on the safe integrity of the treatment room and recommend course of action Prepare reports and documentation	
Special procedures	Fetal dose calculations	Understand methods to minimize dose to the fetus. Perform a Case study	
	Pacemakers, etc.	Understand methods to minimize dose to pacemakers Perform a Case study	
	^{131}I therapy or other	Patient preparation and pre-treatment activities:	

SUB-MODULE	ACTIVITY	PROCEDURES TO ACHIEVE COMPETENCY	COMMENTS, SIGNATURE AND DATE OF SUPERVISOR
	therapeutic procedures using unsealed sources (if applicable)	Determine whether the treatment can be given as an inpatient or outpatient, where the dose should be administered and assess which ward/s are suitable for admission of patients for each type of treatment available Ensure correct radiopharmaceutical and activity is ordered for the specific patient Arrange for appropriate equipment, survey instruments, personal protection and dosimeters to be provided for the purpose of treatment Treatment procedures: Pre-treatment management Protocols and procedures Form of radionuclide to be administered to patient for therapy Patient dose preparation and administration Dose calculation of the appropriate radionuclide to be administered to the patient for therapy Prepare a check-list of the whole procedure Discharge: Safety of family members following discharge Determination of the time frame when the patient can return to work or move in public environment	

TABLE 3.7: PORTFOLIO FOR THE MODULE: Equipment specification and acquisition (TCS No. 37 Sub-modules 4.2, 5.1, 6.1, 7.4) FROM THE REGIONAL CLINICAL TRAINING PROGRAMME FOR RADIOTHERAPY MEDICAL PHYSICS RESIDENTS. THE SUGGESTED DURATION FOR THIS MODULE IS 3 WEEKS.

SUB-MODULE	ACTIVITY	PROCEDURES TO ACHIEVE COMPETENCY	COMMENTS, SIGNATURE AND DATE OF SUPERVISOR
Department needs assessment	Workload Functionality Compatibility Siting	Demonstrate an understanding on process involved in equipment requisition and acquisition Review and report on department needs on: ° Patient load ° Equipment technology ° Functionality ° Performance ° Compatibility ° Training ° Maintenance service ° Building and building services ° Delivery and installation Analyse local and external restrictions placed on new equipment acquisition. Compile and compare local legislative requirements and international recommendations on safety of equipment. Participate in multidisciplinary meetings with professionals and technical staff to decide on the department's requirements for new equipment.	
Technology assessment	Technical specifications : Dosimetry Imaging Treatment units	Perform: ° Market research on equipment technology ° Technology assessment ° Review of procurement documentation	

SUB-MODULE	ACTIVITY	PROCEDURES TO ACHIEVE COMPETENCY	COMMENTS, SIGNATURE AND DATE OF SUPERVISOR
	Treatment Planning Information Technology and networking		
	National tender and procurement process	Prepare/perform in collaboration with other professionals and technical staff: ° Tender specification ° Tender evaluation ° Tender recommendation.	

TABLE 3.8: PORTFOLIO FOR THE MODULE: Quality management (TCS No. 37 Sub-modules 4.6, 7.3, 7.5, 7.6 and BSS Interim Edition Requirements 38 and 41) FROM THE REGIONAL CLINICAL TRAINING PROGRAMME FOR RADIOTHERAPY MEDICAL PHYSICS RESIDENTS. THE SUGGESTED DURATION FOR THIS MODULE IS 4 WEEKS.

SUB-MODULE	ACTIVITY	PROCEDURES TO ACHIEVE COMPETENCY	COMMENTS, SIGNATURE AND DATE OF SUPERVISOR
Performing and documenting QC	Dosimetry instrumentation, equipment, calibration of sources, abiding by well-established good practices (e.g. procedures developed according to International Codes of Practice), developing internal redundancy systems, clinical aspects	Review the department documentation on quality management and write reports	
Auditing	Internal (peer review)	Conduct and report an internal audit	
	External	Demonstrate an understanding of comprehensive auditing principles, e.g. QUATRO [13]. Participate in a national or international dosimetry audit	
Risk management culture	Risk assessments	Demonstrate an understanding of the Risk assessments according to WHO guidelines	
	Investigating incidents and near accidents	Use local institutional incident reporting database and records to develop an understanding of how to investigate and prevent incidents and near accidents.	

ABBREVIATIONS

ATP	Acceptance test procedure
CQMP	Clinically qualified medical physicist
CPD	Continuing professional development
CT	Computed tomography
DRR	Digitally-reconstructed radiograph
EBRT	External beam radiation therapy
FAMPO	Federation of African Medical Physics Orgamizations
GLP	Good Laboratory Practice
HDR	high dose rate
IAEA	International Atomic Energy Agency
ICRU	International Commission on Radiation Units and Measurements
IVD	In-vivo dosimetry
LDR	low dose rate
LINAC	linear accelerator
MRI	Magnetic resonance imaging
PSDL	Primary Standards Dosimetry Laboratory
TPS	Treatment planning system
QA	Quality assurance
QC	Quality control
WHO	World Health Organization

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