DOCUMENT: SAMPS9801ENG

CODE FOR THE SCOPE OF THE PROFESSION OF THE MEDICAL PHYSICIST

1. INTRODUCTION

The medical physicist, in this century, made a valuable contribution towards the development of a multitude of techniques and equipment playing an important role in contemporary medicine. In specific medical disciplines the medical physicist is directly involved in certain patient procedures and techniques and is even responsible for some aspects of these procedures and techniques. This involvement is found primarily in the radiation disciplines, viz. Radiation Oncology, Nuclear Medicine and Radiology. The medical physicist further is responsible for the protection of the public and hospital staff against ionising radiation.

The responsibilities and duties of the medical physicist are described in a number of South African laws and regulations. The Law on Hazardous Substances (Law 15 of 1973) and the regulations referring to this law, describe specific accountabilities and involvement of the medical physicist in the application and regulation of hazardous substances e.g. ionising radiation and LASER-beams in the hospital. "Regulations defining the scope of the profession of medical physicist", were published as Regulation No R310 of 26 February 1988 in terms of section 33(1) of the Medical, Dental and Supplementary Health Service Professions Act, 1974 (Act 56 of 1974).

The above-mentioned Regulation No 310 lists a number of acts which shall for the purposes of the Medical, Dental and Supplementary Health Service Professions Act be deemed to be acts pertaining to the profession of medical physicist. The regulations however do not give a description of the duties involved in the acts mentioned nor of the frequency of the specific duties to be performed. This occupational code will attempt to describe the responsibilities and duties of the medical physicist and to indicate the frequency with which specific duties should be performed.

In the following sections the responsibilities of the medical physicist in Radiation Oncology, Nuclear Medicine, Radiology and Radiation Protection will be summarised.

2. RADIATION ONCOLOGY

The physicist played through the discovery of x-rays by W C Röntgen in 1895 and of radioactivity by H Becquerel in 1896 the leading role in the establishment of radiotherapy as medical treatment modality. In the 1920's physicists were appointed as medical physicists in hospitals in Europe to support the radiotherapists. In the following decades the medical physicists developed dosimetry systems which established the reproducibility and accuracy necessary for clinical success in radiotherapy.

The duties of the medical physicist in oncology will be discussed under the following headings:

- Radiation dosimetry and Quality assurance
- Treatment planning and Treatment
- Acquisition of new equipment and maintenance of equipment
- Teaching and training
- Research and development
- Management

The duties of the medical physicist in radiation oncology are summarised in table 1.

TABLE 1

	Duty	Frequency of performing duty (where applicable)
1	**RADIATION DOSIMETRY AND QUALITY ASSURANCE**	
1.1	**Dosimeters**	
	1. Acquisition of a suitable dosemeter or dosemeters	
	2. Sending of the dosemeter to the CSIR for calibration	Yearly
	3. Testing of the calibration stability of the dosemeter	Monthly
1.2	**Linear accelerators**	
	1. Implementing of the AAPM TG21 protocol for absolute dose measurement of the x-ray and electron beams	At installation of a new accelerator
	2. Absolute measurement of dose for all available x-ray and electron energies applying the TG21 protocol	Weekly Monthly
	3. Testing of the symmetry and flatness of the x-ray and electron beams	Daily
	4. Comparative dose measurements of the available x-ray and electron energies (e.g. with diode detectors)	
	5. Acceptance tests and the accumulation of dose data commissioning of a new linear accelerator	
	6. Mechanical, optical and geometrical quality assurance tests (e.g. testing of beam sizes, isocentre,	

	collimator rotation, vertical couch movement, correspondence of light and radiation beam, alignment of LASERS, etc.)	
1.3	**Cobalt Units**	
	1. Absolute measurement of absorbed dose	Monthly
	2. Acceptance tests and collection of dose data when commissioning of a new cobalt unit	
	3. Mechanical, optical and geometrical quality assurance tests (e.g. testing of beam sizes, isocentre, collimator rotation, vertical couch movement, correspondence of light and radiation beam, alignment of LASERS, etc.)	Weekly
1.4	**Low energy x-ray unit (maximum beam quality 300 kV)**	
	1. Absolute measurement of dose	Weekly
	2. Mechanical and geometrical quality assurance	Monthly
1.5	**Afterloading unit**	
	1. Absolute measurement of dose	Weekly
	2. Quality assurance tests	Monthly
	3. Replacement of the radioactive source or sources and the accompanying tests as required by the specific afterloading unit	As required by the type of source
1.6	**Simulator**	
	1. Acceptance tests at commissioning of a new simulator	Weekly
	2. Quality assurance (mechanical, optical and geometrical tests e.g. tests for beam size, isocentre, collimator rotation)	
1.7	**CT Scanner**	
	1. Quality assurance (image quality, alignment of LASER-beams, couch movements, etc.)	Weekly
1.8	**Unsealed radionuclide therapy**	
	1. Determination of the activity of unsealed radionuclides and the administration of these nuclides in specific cases (e.g. oral administration)	
2	**PLANNING AND TREATMENT**	
	1. Acceptance and commissioning of a treatment planning system.	
	2. Input of beam data into the treatment planning computer and verification of beam data of the various treatment units (cobalt unit, linear accelerator, afterloading unit).	
	3. Quality assurance and management of software on the planning computer.	Monthly
	4. Assistance in calculating dose distributions for individual patients.	Daily
	5. Consultation with regard to the localisation	

	procedures, simulation of planned treatments and the design and manufacturing of special devices for specific patients. 6. Inspection and verification of the treatment plan for **each patient** before commencement of treatment. 7. Absorbed dose measurement for individual patients as required. 8. Verification of the absorbed dose which is prescribed by performing in vivo dosimetry on **individual patients**. 9. Calculation of dose distributions for patients receiving brachytherapy with sealed radioactive sources. 10. Participate in the design and manufacture of devices e.g. shielding block by the radiotherapy laboratory and a ^{192}Ir wire cutter by the workshop.	Weekly
3	**ACQUISITION OF NEW EQUIPMENT AND MAINTENANCE OF EQUIPMENT**	
	1. Writing specifications for new equipment after consultation with radiation oncologists and radiographers. 2. Evaluation of tenders submitted and drafting of recommendations for purchasing of equipment after consultation with radiation oncologists and radiographers. 3. Commissioning and acceptance of equipment as well as the training of staff in the use of equipment. 4. Management and supervision of the maintenance of equipment.	
4	**TEACHING AND TRAINING**	
4.1	The medical physicist participates in the formal academic teaching and practical training of the following students: 1. Post-graduate and in-service training of medical physics students. 2. Physicians specialising in radiation oncology. 3. Radiography students. 4. Radiation technology students.	
4.2	Teaching radiation protection to radiation workers.	
4.3	Training in the use of new equipment.	
5	**RESEARCH AND DEVELOPMENT**	
5.1	Independent research and development in medical physics aspects of radiation oncology.	

5.2	Participation in the research and development projects of the radiation oncologists.	
6	**MANAGEMENT**	
	The management functions of the medical physicist include:	
6.1	Managing the medical physics department.	
6.2	Managing the workshop.	
6.3	Managing the radiation technology laboratory.	
6.4	Drafting the budget for the medical physics department as well as the equipment budget for the Department of Radiation Oncology (if requested).	
6.5	Act as member of the management team of the Department of Radiation Oncology.	

3. NUCLEAR MEDICINE

Nuclear medicine involves the use of radioactive pharmaceuticals for medical diagnosis and treatment. It is a multidisciplinary activity, involving medical physicists, physicians, radiographers, radiopharmacists, nurses and others. The medical physicist provides specialist knowledge, which is essential for the rendering of an effective nuclear medicine service.

The duties of the medical physicist in nuclear medicine will be discussed under the following headings:

- Quality assurance
- Data processing procedures
- Unsealed radionuclide therapy
- Acquisition of new equipment and maintenance of equipment
- Teaching and training
- Research and development
- Management

The duties of the medical physicist in nuclear medicine are summarised in Table 2.

TABLE 2

	Duty	Frequency of performing duty (where applicable)
1	**QUALITY ASSURANCE**	
1.1	**Scintillation cameras – planar tests**	
	1. Flood field uniformity (visual)	Daily
	2. Flood field uniformity (NEMA procedure)	Weekly
	3. Spatial resolution (visual with bar phantom)	Daily
	4. Intrinsic spatial resolution (NEMA procedure)	Weekly
	5. Intrinsic energy resolution	Monthly
	6. Intrinsic count rate performance in air	Quarterly
	7. System flood field uniformity	Semi-annually
	8. Multiple window spatial registration	Annually
	9. Acceptance testing of new equipment	
1.2	**Scintillation cameras – tomographic tests**	
	1. Flood field acquisition	Weekly
	2. Centre of rotation determination	Monthly
	3. Angular uniformity and sensitivity	Quarterly
	4. Spatial resolution	Quarterly
	5. System performance: tomographic uniformity	Semi-annually
	6. System performance: contrast	Semi-annually
	7. Acceptance testing of new equipment	
1.3	**Scintillation counters**	
	1. Photopeak calibration	Before use

	2. Energy resolution	Monthly
1.4	**Hard copy imaging systems**	
	1. Image formatter: Contrast tests	Monthly
	2. Paper printer: Contrast tests	Monthly
	3. Film processor: Sensitometry tests	Daily/weekly
2	**DATA PROCESSING PROCEDURES**	
2.1	**Image processing systems**	
	1. Special procedures	
	2. Software development	
	3. Software maintenance	
	4. Acceptance testing of new equipment	
2.2	**Radionuclide counting systems**	
	1. Software development for special procedures	
	2. Software maintenance	
3	**UNSEALED RADIONUCLIDE THERAPY**	
	1. Determination of the activity of unsealed radionuclides and the administration of these nuclides in specific cases (e.g. oral administration).	
	2. Monitoring of patients treated with radionuclides to determine when the patient may be discharged.	
4	**ACQUISITION OF NEW EQUIPMENT AND MAINTENANCE OF EQUIPMENT**	
	1. Writing specifications for new equipment after consultation with nuclear medicine physicians and radiographers.	
	2. Evaluation of tenders submitted and drafting of recommendations for purchasing of equipment after consultation with nuclear medicine physicians and radiographers.	
	3. Commissioning and acceptance of equipment as well as the training of staff in the use of equipment.	
	4. Management and supervision of the maintenance of equipment.	
5	**TEACHING AND TRAINING**	
5.1	The medical physicist participates in the formal academic teaching and practical training of the following students:	
	1. Post-graduate and in-service training of medical physics students.	
	2. Physicians specialising in nuclear medicine.	
	3. Radiography students.	

5.2	Teaching radiation protection to radiation workers.	
5.3	Training in the use of new equipment.	
6	**RESEARCH AND DEVELOPMENT**	
6.1	Independent research and development in medical physics aspects of nuclear medicine.	
6.2	Participation in the research and development projects of nuclear medicine physicians.	
7	**MANAGEMENT**	
	The management functions of the medical physicist include:	
7.1	Managing the medical physics responsibilities towards the nuclear medicine department.	
7.2	Assistance in drafting the equipment budget for the nuclear medicine department.	
7.3	Act as member of the management team of the nuclear medicine department (if requested).	

4. RADIOLOGY

Starting with the discovery of x-rays in 1895 the medical physicist has maintained a close involvement in the development of medical radiology in the past 100 years. The medical physicists participated in the development of equipment, the control and monitoring of radiation doses to patients, staff and the public and in efficiency tests of equipment.

The duties of the medical physicist in diagnostic radiology will be discussed under the following headings :

- Quality assurance
- Acquisition of new aquipment and maintenance of equipment
- Teaching and training
- Research and development
- Management

The duties of the medical physicist in diagnostic radiology are listed in Table 3.

TABLE 3

	Duty	**Frequency of performing duty (when applicable)**
1	**QUALITY ASSURANCE.**	
1.1	**The darkroom**	
	1. Light tightness of darkroom	Annually
	2. Light tightness of film tray	Annually
	3. Emergency lights in darkroom	Annually
1.2	**Film processors**	
	1. Check time and temperature	Monthly
	2. Test sensitometer	Monthly
	3. Test densitometer	Monthly
	4. Characteristic curve	At installation or use of new types of chemicals or films
	5. Set-up of base values	Start of use of new box of films
	6. Base plus fog density	Daily
	7. Speed index	Daily
	8. Contrast index	Daily
1.3	**Light boxes**	Six-monthly
1.4	**Grid alignment**	Annually
1.5	**Film-Screen contact**	Annually
1.6	**X-ray tube**	
	1. Focus size	Annually
	2. Leak radiation	Annually
1.7	**X-ray Generator**	
	1. Wave form	Annually
	2. Peak tube potential and repeatability	Annually

	3. Timer calibration and repeatability	Annually
	4. Tube current calibration and repeatability	Annually
	5. Tube current stability	Annually
	6. Output stability	Annually
	7. Half-value layer thickness	Annually
1.8	**Collimation and Alignment**	
	1. Bucky alignment	Six-monthly
	2. Coincidence and alignment	Annually
1.9	**Automatic exposure control**	Annually
1.10	**Image Intensifiers**	
	1. Fluoroscopic high contrast resolution	Annually
	2. Maximum exposure	Annually
1.11	**Tomography**	
	1. Localisation of image plane	Annually
	2. Plane thickness	Annually
	3. Plane resolution	Annually
	4. Uniformity of exposure in imaging plane	Annually
	5. Beam path during an exposure	Annually
1.12	**Mammography**	
	1. Dark room	Annually
	2. Film processor	Six-monthly
	3. Cassettes and screens	Six-monthly
	4. X-ray generator and tube	Six-monthly
	5. Automatic exposure controls	Six-monthly
	6. Patient dose	Six-monthly
1.13	**Computed tomography**	
	1. High contrast resolution	Weekly
	2. Contrast scale (monitor CT #)	Weekly
	3. Slice thickness	Weekly
	4. Positioning light accuracy	Weekly
	5. Low contrast delectability	Weekly
	6. Noise and uniformity	Weekly
	7. Table movement	Monthly
	8. Houndsfield calibration	Monthly
1.14	**Magnetic Resonance Imaging (MRI) units**	
	1. Spatial resolution	Monthly
	2. Uniformity and SNR	Monthly
	3. Linearity	Monthly
	4. Slice thickness	Monthly
	5. Slice distances	Monthly
	6. Resonant Frequency	Monthly
	7. Monitor He level	Monthly
1.15	**Diagnostic ultrasound units**	
	1. Penetration	Monthly
	2. Resolution: horizontal, vertical	Monthly
2	**ACQUISITION OF NEW EQUIPMENT AND MAINTENANCE OF EQUIPMENT**	

1. Writing specifications for new equipment after consultation with diagnostic radiology physicians and radiographers.
2. Evaluation of tenders submitted and drafting of recommendations for purchasing of equipment after consultation with diagnostic radiology physicians and radiographers.
3. Commissioning and acceptance of equipment as well as the training of staff in the use of equipment.
4. Management and supervision of the maintenance of equipment.

3 TEACHING AND TRAINING

3.1 The medical physicist participates in the formal academic teaching and practical training of the following students:

1. Post-graduate and in-service training of medical physics students.
2. Physicians specialising in diagnostic radiology.
3. Radiography students.

3.2 Teaching radiation protection to radiation workers.

3.3 Training in the use of new equipment.

4 RESEARCH AND DEVELOPMENT

4.1 Independent research and development in medical physics aspects of diagnostic radiology.

4.2 Participation in the research and development projects of diagnostic radiology physicians.

5 MANAGEMENT

The management functions of the medical physicist include:

5.1 Managing the medical physics responsibilities towards the diagnostic radiology department.

5.2 Assistance in drafting the equipment budget for diagnostic radiology department.

5.3 Act as member of the management team of the diagnostic radiology department (if requested).

5. RADIATION PROTECTION

The duties of the medical physicist in radiation protection will be discussed under the following headings:

- Radiation Oncology
- Nuclear Medicine
- Radiology
- General

The duties of the medical physicist in the protection of patients, staff and the public in the hospital environment are listed in Table 4.

TABLE 4

	Duty	Frequency of performing duty (when applicable)
1	**RADIATION ONCOLOGY**	
1.1	Involvement in the planning phase for the acquisition of radiation equipment and the erection of building structures to provide for the safety of staff and the public.	
1.2	Drafting of a set of "Internal Rules" regarding the storage, handling and disposal of radioactive nuclides in the hospital.	
1.3	Environmental monitoring and quality assurance on safety devices e.g. door interlocks to assure the safe use of radiation equipment.	Weekly
1.4	Leakage tests on sealed radioactive sources.	Annually
1.5	Participation in treatment planning to effect radiation protection of individual patients.	Daily
1.6	Calibration of radiation measuring devices.	Annually
1.7	Monitoring of patients treated with radionuclides to determine when the patient may be discharged.	
2	**NUCLEAR MEDICINE**	
2.1	**Personnel dosimetry**	
	1. Monitoring of hot lab personnel	Weekly
	2. Monitoring of pregnant radiation workers	Daily
2.2	**Radiation measuring devices**	
	1. Acquisition of suitable dosimeters	
	2. Maintenance of dosimeters	Monthly
	3. Calibration of radiation measuring devices	Annually
2.3	**Internal radiation dosimetry**	
	1. Calculation of radiation dose due to specific nuclear medicine procedures	
	2. Calculation of radiation dose from new	

examinations
3. Consultation on dosimetry matters

2.4 **General protection responsibilities**
1. Decontamination of radionuclide spills
2. Drafting of a set of "Internal Rules" regarding the storage, handling and disposal of radioactive nuclides in the hospital.

3 RADIOLOGY

3.1 The development, implementation and maintenance of techniques for determining doses to patients

3.2 monitor radiation doses to staff in Radiology Departments

3.3 Advise on radiological techniques to assure that radiation doses, to both staff and patients, comply to the ALARA (As Low As Reasonably Achievable) principle.

3.4 Advise on protection measures that can be implemented to avoid the hazards associated with the use of MRI and Ultrasound.

4 GENERAL

4.1 Participation in the general management of radiation protection in the hospital, e.g. as a member of the Radionuclide Advisory Committee.

4.2 Advice to the users of radionuclides and ionising radiation regarding safety aspects, the application of regulations pertaining to hazardous substances and of the Local Rules.

4.3 Administrative control of the licensing of devices producing ionising radiation.

4.4 Administration of the registration of radiation workers and the termination of registration, the maintenance of a register of radiation workers and of the results of medical examinations as well as accumulated doses registered by personal monitors.

4.7 Environmental monitoring to determine dose equivalent levels as required.

4.8 Teaching in radiation protection.

ANNEXURES