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EUROPEAN GUIDELINES ON MEDICAL PHYSICS EXPERT

ANNEX 2

Medical Physics Expert Staffing Levels in Europe

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The statements and recommendations of this report do not necessarily reflect the position of the European Commission.

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1. Medical Physics Staffing levels in Radiotherapy

The number of MPEs (Medical Physics Expert) required for a radiotherapy service will depend on the number and type of equipment and also the number of patients treated (or planned).

The MPE factors are indicated for external beam and brachytherapy (for radionuclide therapy factors see under nuclear medicine) and include additional components for special procedures such as IMRT, IGRT and SBRT(SABR). The factors also take into account MPE involvement in education, administration, computer support and developmental time.

The number of MPEs required for the radiotherapy departments depends upon: the amount and complexity of used equipment, the number of patients treated and the complexity of treatments together with departmental working arrangements.

The core tasks of the MPE taken into account for deriving the WTE (Whole Time Equivalent) factors were: equipment specification, ensuring the accurate calibration of the treatment equipment, acceptance testing and commissioning, radiological protection of the patient and (often) the workers - normally in liaison with a radiation protection expert, having full responsibility for the scientific aspects of the treatment planning process including setting up protocols for standardised treatments, being closely involved in the establishment of all new techniques and with any deviation from standard practice, providing appropriate supervision in order to be closely involved in the treatment, and being involved in various procedures, such as dosimetry measurements and treatment planning, to retain a considerable amount of practical experience.

Other tasks taken into account in deriving the WTE factors for the MPE were: management, development and scientific direction of the MPS (Medical Physics Service), ensuring the accuracy of radiotherapy treatment through scientific supervision of dose, calculation procedures and of ongoing quality control of both equipment and treatment planning, design and implementation of new and innovative treatments, leadership of research and development - especially in the technological basis of radiotherapy, providing advice on appropriate treatment techniques, ensuring radiation safety, management of computer systems, equipment management and procurement (both for treatment units and radiological protection), and teaching and training of staff.

An estimate of the number of MPEs required as a function of WTE is shown in Table 1.

Table 1: MPE Staffing Factors for Radiotherapy

Equipment Dependent Factors		Item	MPE WTE	MPS WTE
	Linear Accelerator	Multi-mode	0.6	1.2
	Linear Accelerator	Single-mode	0.2	0.9
	IGRT	Unit	0.1	0.2
	HDR	Unit	0.2	0.4
	CT Simulator	Unit	0.2	0.4
	Planning	System	0.1	0.4

	IMRT	Unit	0.2	0.4
	RT Data/Imaging	Data Network	0.1	0.4
	Simulator	Unit	0.1	0.4
	MLC	Unit	0.05	0.2
	EPID	Unit	0.05	0.2
	Advanced/Brachy TPS	Unit	0.1	0.2
	300 kV	Unit	0.05	0.2
	150 kV	Unit	0.05	0.2
	Low Dose After-loading	Unit	0.1	0.4
	Block Cutter	Unit	0.05	0.2
	Automatic Outlining	Unit	0.05	0.2
	SBRT (new)	Unit	0.2	0.2
	SBRT (established)	Unit	0.1	0.2
Patient Dependent Factors		**No. of Courses**	**MPE WTE**	**MPS WTE**
New patients	External	1000	0.5	1.8
	3D Conformal	100	0.1	0.4
	TBI	100	0.4	0.8
	SBRT/SABR	100	0.4	0.8
	IMRT	100	0.4	0.8
	Total Skin Electrons	100	0.4	0.8
New patients	Brachytherapy	100	0.4	0.8
	I-125	100	0.4	0.8
Service Dependent Factors		**Notes**	**MPE WTE**	**MPS WTE**
Practical Radiation Protection Support		Per centre	0.1	0.1
Quality System		Per centre	0.2	0.5
Research and Training Dependant Factors		**Notes**	**MPE WTE**	**MPS WTE**
Research and Development including clinical research		Per department	0.2	0.3
Delivering training – internal		Per trainee	0.2	0.3
Education and training within service		Per department	0.04	0.05
Clinical Trials with trial specific QA requirements		Per trial	0.1	0.125

Notes

a. The minimum number of MPEs should be made at least two in order to cover for absences and respond to any emergency situation. Similarly, the number of staff within the other groups must be adequate to cover for absences.

b. The number of staff in the MPS does not include Clinical Engineers/Technologists for equipment support and maintenance since this will depend upon the extent to which maintenance is carried out in-house.

c. For major items of equipment (e.g. CT scanners, HDR units) not included in the above table a WTE of 0.4 MPS would be appropriate.

d. For minor items of equipment (e.g. IGRT systems, orthovoltage units) not included in the above table a WTE of 0.2 MPS would be appropriate.

e. For clarity, the MPS WTE includes the MPE WTE.

These factors include all elements such as education and training, committees and meetings, administration and management.

At the start of a procurement process it should be noted that a significant time is required to appropriately specify and evaluate the equipment. Acceptance testing and commissioning will

require additional staffing to ensure this is undertaken in a timely manner and to ensure the integrity of the process.

National and international trials involving radiotherapy require detailed implementation by an MPE. It is recommended that one WTE MPE is associated with every 8 clinical trials for initial set-up and maintenance of the trials.

An example of the staffing requirements associated with a typical radiotherapy centre is given in Appendix A.1.

2. Medical Physics Staffing levels in Nuclear Medicine

The core duties and responsibilities of the MPE in a nuclear medicine department are related to: equipment technical specifications and procurement (for both imaging equipment and radiological protection instrumentation), establishing procedures, providing equipment quality assurance, acceptance testing and commissioning, ensuring adequate image quality is obtained in the most dose efficient way, optimisation of the medical exposures, and the radiological protection of the patient and (often) the workers - normally in liaison with a radiation protection expert, and other service related factors. Other activities include: teaching, staff education, administrative activities, committees, and attending meetings.

The MPE deals with patients in two groups: diagnostic studies and radionuclide therapy. In some departments, radionuclide therapy is undertaken by radiotherapy services.

An estimate of the number of MPEs required as a function of WTE is shown in the Table 2.

Table 2: MPE Staffing Factors for Nuclear Medicine

Equipment Dependent Factors	Item	MPE WTE	MPS WTE
Planar Gamma Camera	unit	0.02	0.05
Multi-head SPECT Gamma Camera - 99mTc only	unit	0.05	0.1
Multi-head SPECT CT Gamma Camera – 99mTc only	unit	0.05	0.1
Multi-head SPECT CT Gamma Camera - range of radionuclides	unit	0.1	0.2
PET/CT Camera – new installation	unit	0.3	0.5
PET/CT Camera – established installation	unit	0.1	0.2
Image Processing and Review on first Workstation	unit	0.05	0.1
Image Processing and Review on subsequent Workstations	unit	0.01	0.03
IT support for simple networked systems and workstations	unit	0.02	0.05
IT support for complex networked systems and workstations	unit	0.05	0.1
Automatic Gamma Counter	unit	0.01	0.05
Radionuclide Calibrator	unit	0.01	0.03

Patient Dependent Factors	No. of procedures	MPE WTE	MPS WTE
Planar imaging procedures not involving data processing	3 types	0.005	0.01
Imaging procedures involving data processing (e.g. renogram) with quantification or tomographic reconstruction (SPECT or SPECT/CT)	100	0.01	0.02
FDG oncology PET/CT imaging procedures	100	0.02	0.05
Any other PET/CT imaging procedures, without post-processing/quantification	100	0.02	0.05
Outpatient radionuclide therapy (e.g. 131-Iodide for ca. thyrotoxicosis)	50	0.01	0.03
Simple inpatient radionuclide therapy (e.g. 131-Iodide for ca. thyroid)	10	0.005	0.01
Complex radionuclide therapy (e.g. 131-mIBG, 177Lu, 90Y agents, monoclonal antibodies, novel bone pain palliation agents, labelled microspheres)	10	0.07	0.1
Non-imaging, laboratory procedures	100	0.01	0.03
Service Dependent Factors (3 Gamma Camera Department)	**Notes**	**MPE WTE**	**MPS WTE**
Ongoing service development	Per department	0.2	0.3
Clinical Governance including on-going audits	Per department	0.2	0.3
Practical radiation protection support	Per department	0.1	0.3
Management of scientific service	Per department	0.1	0.1
Research and Training Dependant Factors	**Notes**	**MPE WTE**	**MPS WTE**
Research and Development including clinical research	Per department	0.2	0.3
Delivering training – internal	Per trainee	0.2	0.3
Education and training within service	Per department	0.04	0.05
Clinical Trials with trial specific QA requirements	Per department	0.04	0.05

Notes

a. *Adequate provision must be made to cover for absences.*
b. *The installation of cyclotrons was considered to be outside the scope of this work and will need to be considered separately.*
c. *The WTE factors associated with the manufacture of radiopharmaceuticals was considered to be outside the scope of this work and will need to be identified separately.*
d. *For clarity, the MPS WTE includes the MPE WTE.*

An example of the staffing requirements associated with a typical nuclear medicine department is given in Appendix A.2.

3. Medical Physics Staffing levels in Diagnostic and Interventional Radiology

The core duties and responsibilities of the MPE associated with a diagnostic and interventional radiology service are related to installation design, defining the technical specification of the equipment, establishing procedures, equipment quality assurance and the radiological protection of the patient and (often) the workers, normally in liaison with a radiation protection expert.

The core tasks associated with each category of equipment are: quality control checks (on site), quality assurance (analysis and reporting), optimisation: troubleshooting protocols flagged by users, optimisation: troubleshooting protocols flagged by dose audit, dose audit/calculation, acceptance testing/commissioning of systems, acceptance testing/commissioning of component e.g. x-ray tube/detector, optimisation: setting up exposure protocols, examination of newly installed equipment for the purposes of ensuring the safety features and warning devices operate correctly and there is sufficient protection provided, together with other support/advice. Other activities associated with the MPE are: advising on and reviewing clinical research studies, delivering teaching and training, research and development, equipment specification and evaluation, radiation protection for new installations, testing protocol development and management.

An estimate of the number of MPEs required as a function of WTE is shown in Table 3.

Table 3: MPE Staffing Factors for Diagnostic and Interventional Radiology

Equipment Dependent Factors	Item	MPE WTE	MPS WTE
CT scanners (portable, dual or single source excluding radiotherapy)	unit	0.02	0.07
CT scanners - multi-modal (e.g. PET-CT, SPECT-CT etc.)	unit	0.01	0.03
Digital mammography systems (computed radiography and direct digital)	unit	0.02	0.07
Analogue mammography systems (film based)	unit	0.01	0.04
Fixed radiography systems (number of x-ray generators installed in a room)	unit	0.01	0.03
Portable radiography systems	unit	0.004	0.02
Fixed fluoroscopy systems (single or bi-plane systems)	unit	0.01	0.04
Fixed interventional systems (including cath. labs)	unit	0.01	0.04
Mobile C-arms	unit	0.006	0.03
Digital radiography detectors (excluding mammography)	unit	0.006	0.02
Computed radiography readers(excluding mammography)	unit	0.004	0.02
Conventional dental x-ray equipment (intra-oral, panoramic systems)	unit	0.002	0.01
Dental cone-beam CT scanners	unit	0.003	0.02
Bone density scanners (all types including peripheral quantitative CT)	unit	0.001	0.01
Image display device (CRT and LCD primary/reporting monitors)	pairs of monitors	0.0005	0.003

Imaging specimen cabinets (e.g. those used in breast imaging)	unit	0.0005	0.003
MV imagers in radiotherapy	unit	0.02	0.05
kV imagers in radiotherapy (for planar imaging and CBCT)	unit	0.01	0.04
CT scanners used in radiotherapy	unit	0.02	0.06
Radiotherapy simulators	unit	0.01	0.03
Other integrated radiotherapy imaging equipment (e.g. tomotherapy)	unit	0.001	0.005
Patient Dependent Factors	**No. of patients**	**MPE WTE**	**MPS WTE**
Patient dosimetry in Interventional Radiology and Cardiology	1000	0.02	0.04
Estimation of skin dosimetry and follow up (high doses)	50	0.005	0.01
Patient dosimetry in CT	1000	0.01	0.02
Risk assessment in pregnant patients	10	0.005	0.01
Service Dependent Factors	***Notes***	**MPE WTE**	**MPS WTE**
Equipment specification	Per procurement	0.007	0.01
Equipment evaluation	Per procurement	0.01	0.02
Radiation protection advice for new installations	Per installation	0.005	0.01
Practical radiation protection support	Per service	0.05	0.1
Testing protocol development	Per service	0.08	0.2
Research and Training Dependent Factors	***Notes***	**MPE WTE**	**MPS WTE**
Lead MPE assessment for application to Research Ethics Committee	Per project	0.004	0.004
Local MPE review of approved research studies	Per project	0.002	0.002
Delivering training – external	Per attendee	0.0007	0.001
Delivering training – internal	Per trainee	0.2	0.3
Delivering academic teaching	Per attendee	0.003	0.004
Carrying out research lead by the service	Per project	0.08	0.2
Support provided to research projects external to the service	Per project	0.02	0.03

Notes

a. *Adequate provision must be made to cover for absences.*
b. *For clarity, the MPS WTE includes the MPE WTE.*

An example of the staffing requirements associated with a typical diagnostic and interventional radiology department is given in Appendix A.3.

APPENDIX A: Examples of MPE Staffing Levels for Radiotherapy, Nuclear Medicine and Diagnostic and Interventional Radiology services

A1.Examples of MPE Staffing Levels for Radiotherapy

In order to provide clarity with the above recommendations, it is useful to consider a radiotherapy service that has:

- 3 multi-energy linear accelerators with MLC's, virtual wedge and portal imaging systems,
- 1 with IMRT
- 1 with stereotactic body radiotherapy (SBRT)
- 1 CT-simulator;
- 1 3D treatment planning system with advanced modules (IMRT, SBRT);
- 1600 treatments per year,
- 600 of them with 3D planning,
- 100 with IMRT and
- 100 with SBRT.

Table 1: Calculation of staffing levels in Radiotherapy

	MPE WTE	MPS WTE
Equipment Dependent	2.7	5.8
Patient Dependent	2.2	6.9
Service Dependent	0.3	0.6
Research and Training*	0.5	0.8
TOTAL	**5.7**	**14.1**

**** multiplying each factor in this section by 1***

For a department consisting of the above units and patient activity 5.7 WTE MPEs are required. This may be rounded to 5 WTE MPEs but the total staffing levels must be kept as calculated. In this example it is possible 1 MPE will be the lead for external beam, 1 for brachytherapy, 1 for treatment planning, 1 for unsealed therapies and 1 for advanced, highly complex and novel treatments and those involving clinical trials.

A2.Example of MPE Staffing Levels for Nuclear Medicine

In order to provide clarity with the above recommendations we consider a Nuclear Medicine department that has:

– 3 SPECT cameras;

- 3 computerised systems for image analysis;
- 4 non-imaging systems;
- 5000 SPECT studies per year
- 200 outpatient radionuclide treatments.

Table 2: Calculation of staffing levels in Nuclear Medicine

	MPE WTE	MPS WTE
Equipment Dependent	0.4	0.9
Patient Dependent	0.5	1.1
Service Dependent	0.6	0.9
Research and Training*	0.5	0.7
TOTAL	**2.0**	**3.6**

**** multiplying each factor in this section by 1***

A3.Example of MPE Staffing Levels for Diagnostic and Interventional Radiology

In order to provide clarity with the above recommendations we consider an x-ray department that has:

- 2 CT scanners,
- 10 fixed x-ray units,
- 2 interventional fluoroscopy units,
- 3 analogue mammography units, and
- analysis of patient doses in Interventional Radiology and Cardiology involving 5,000 patients,
- estimations of patient skin doses and follow up for high doses on 50 patients,
- analysis of patient doses in CT involving 10,000 patients,
- risk assessments for 10 pregnant patients.

Table 3: Calculation of staffing levels in Radiology

	MPE WTE	MPS WTE
Equipment Dependant	0.2	0.6
Patient Dependant	0.2	0.4
Service Dependant	0.2	0.4
Research and Training*	0.3	0.5
TOTAL	**0.9**	**1.9**

**** multiplying each factor in this section by 1***

For a department consisting of the above units and patient activity 0.9 WTE MPEs are required. This may be rounded to 1 WTE MPE but the total staffing levels must be kept as calculated.