THE EUROPEAN FEDERATION
OF ORGANISATIONS FOR MEDICAL PHYSICS

Policy Statement

Criteria for the staffing levels in a Medical Physics Department

Approved by EFOMP Council September 1997

PREAMBLE

Modern Health Care Services are provided with ever-increasing demands for competence, specialization and cost effectiveness. The Medical Physics Service as practised in hospitals faces the same demands. The Hospital Physicist has to make decisions with consequences for the patient and such decisions are based on a competence which only the discipline of Medical Physics covers. These facts have to be taken into account within the organisation and management of the Medical Physics Service.

INTRODUCTION

Medical Physics can be described as the scientific discipline which is concerned with the application of the concepts and methods of physics in medicine.

In the opinion of the European Federation of Organisations for Medical Physics (EFOMP) Medical Physics is a Health Care Profession and the Medical Physicist whose training and function are specifically directed towards Health Care is entitled to an official recognition as a specialist. High standards in Medical Physics Services are important and at a time of increasing demand sufficient resources must be directed towards an appropriate, safe and cost effective use of physical sciences in the Health Service for the benefit and safety of the patient.

MEDICAL PHYSICIST

The formal entry qualification to the profession of Medical Physics is academic with physical sciences as an essential component of the training. A formalised in-service training scheme must be completed successfully before a physicist may proceed to a position in a hospital Medical Physics Department that is higher than the training grade. A certificate or diploma should be given to the candidate to recognize successful completion of training and to enroll in a National Registration Scheme for Medical Physicists [1)].

A qualified Medical Physicist is an individual who is competent to practice independently and to Register as a Medical Physicist ,one or more of the subfields of medical physics e.g. therapeutic radiological physics, diagnostic radiological physics, medical nuclear physics, radiation protection physics or one of the many branches of medical physics that does not involve the use of ionising radiation. To act as an expert further experience is required and an involvement in a programme for Continuing Professional Development is recommended [2)].

LEGAL REQUIREMENTS

EEC Directive 97/43/Euratom [3)] contains in article 2 the following definition: Medical Physics Expert: an expert in radiation physics or radiation technology applied to

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[1]Physica Medica, 11: 157 - 159, 1995
[2]Physica Medica, 12: 279 - 282, 1996
[3] Official Journal of the European Communities No L180, 9.7.1997, p. 22

exposure, within the scope of this Directive, whose training and competence to act is recognized by the competent authorities; and who, as appropriate, acts or gives advice on patient dosimetry, on the development and use of complex techniques and equipment, on optimization, on quality assurance, including quality control, and on other matters relating to radiation protection, concerning exposure within the scope of this Directive.

Article 6 contains the following statement: In radiotherapeutic practices, a medical physics expert shall be closely involved. In standardized therapeutical nuclear medicine practices and in diagnostic nuclear medicine practices, a medical physics expert shall be available. For other radiological practices, a medical physics expert shall be involved, as appropriate, for consultation on optimization including patient dosimetry and quality assurance including quality control, and also to give advice on matters relating to radiation protection concerning medical exposure, as required.

MEDICAL PHYSICS DEPARTMENT

The Organisation of Medical Physics Services in Health Care varies widely throughout Europe. The highest standards and most cost effective provision of services are usually obtained if the service is organized by an independent Department of Medical Physics. That means that the head of the department is an experienced Medical Physicist with responsibility for professional standards, provision of scientific services and for the departments budget. These responsibilities may be within a hospital or within a region. Small departments are likely to be relatively more expensive and less efficient, at the risk of the quality and availability of services to be reduced and the level of safety for patients may be compromised. Therefore it is recommended that small departments have collaboration with a larger department.

Medical Physics Departments generally serve a variety of medical specialities. In some countries the Medical Physics Service is still restricted mainly to the radiological field (radiotherapy, nuclear medicine, X-ray diagnostics and radiation protection), where the service has a long and recognised tradition. In other countries services are already provided to magnetic resonance and ultrasound imaging, physiological measurements, clinical applications of non-ionising radiations (lasers, ultraviolet light and microwaves), bioengineering, electronics, information technology, general data processing and computer technology. The role of medical physics in these areas is expected to increase in the future.

Because the Medical Physicist must have in depth understanding of techniques used for examinations or treatments there must be close daily relationship between the Medical Physicist and the patient environment especially the medical staff. The Medical Physics Department should therefore be close to relevant clinical areas. EFOMP has issued a policy statement entitled “Departments of Medical Physics: Advantages, Organisation and Management” [4].

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[4] Physica Medica, 11: 126 - 128, 1995

GENERAL OBSERVATIONS ON STAFFING THE MEDICAL PHYSICS DEPARTMENT

Generally the total number of staff required in a Medical Physics Department depends upon:

(i) the range of applications of physics service to medicine
(ii) the scale of organisational and management responsibilities (number of hospitals, population served)
(iii) the amount and complexity of equipment and procedures used in related clinical specialities
(iv) the number of patients examined and treated in the relevant modalities and the complexities of these examinations or treatments
(v) the load for formal teaching and training
(vi) the level of participation in maintenance, development, research and clinical trials

The number of Medical Physicists per million inhabitants shows wide variations in different European countries, from less than 2 in Portugal to 15 in Sweden (1994). Figures can be used in comparisons between countries only if they are covering the same areas of physics related activities. Variations between departments in the same country also depend on the range of physics related activities together with the number and qualifications of the supporting staff. Largely for this reason, it is difficult to specify appropriate staffing levels. However in radiotherapy and partly in nuclear medicine, diagnostic radiology and radiation protection there now exists legal requirements for the services of a physicist, who has the status of an expert in radiation physics related to these disciplines [3)]. Therefore, for these services it is appropriate to make recommendations on minimum staffing in the Medical Physics Department. The following general points apply to the staffing figures given.

1. The staffing levels are oriented on institutions with typical basic equipment and agreed quality standards. The figures are intended to apply to the provision of the core service, covering tasks which are common to all centres. Additional areas of work, more sophisticated techniques, etc. require separate consideration, with appropriate additional staffing to be determined locally, taking into account local requirements and standards.

2. Additional staff are required for provision of the equipment maintenance service and more extensive computing support.

3. Staffing for radiation protection duties directly related to routine radiotherapy, nuclear medicine or diagnostic radiology are included in the relevant sections. Staffing for more general radiation protection duties are dealt with in separate section no. 4..

4. Additional staff are required if there are research activities or training responsibilities. Physicists who have academic commitments in University Hospitals should be scored taking into account the time spent on these commitments.

5. In the case of a Medical Physics Department serving all radiological disciplines some duties may be shared, resulting in more efficient use of manpower.

In Appendix I a catalogue of core tasks for the medical physics support of routine work in each of the four disciplines, is given. Usually all or at least some of the tasks listed will be performed by a Qualified Medical Physicist, by other specialists supervised by a qualified medical physicist, or a Department/Section of Medical Physics employing physicists, engineers, technicians and assistants. In the Appendix II examples of staffing levels are given.

MINIMUM STAFFING OF THE MEDICAL PHYSICS SUPPORT OF RADIOTHERAPY

1.1 Only staff who have had an approved course of training in radiation physics related to radiotherapy should be included in the minimum staffing level of qualified medical physicists.

1.2 In all departments at least one medical physicist, qualified in radiotherapy physics familiar with the equipment and the procedures common at the institution, must be permanently available.

1.3 Minimum staffing levels should be calculated from factors depending both on equipment load, number of patients treated and sophistication of treatments.

General guidelines are given below (WTE = whole time equivalent) for assessment of minimum medical physics staffing levels for routine clinical work in radiotherapy [4)]

Subject	Total staff (WTE)	Minimum number of qualified medical physicists within total staff (WTE)
Accelerator	0.88	0.37
Cobalt	0.34	0.14
Conv. X-ray	0.07	0.03
Afterloading	0.42	0.18
Simulator	0.30	0.13
Treatment Planning System:		
External beam therapy	0.38	0.16
Brachytherapy	0.08	0.04
100 patients/year*		
External beam therapy	0.27	0.11
Brachytherapy	0.22	0.09

*) "100 patients/year" relates to new patients, renewed treatments or new treatment plans, such as for a new target region.

The above WTE's have to be multiplied by the number of subjects and summed to calculate the total number of physics staffing.

4) Radiother.Oncol. 41: 89 - 94, 1996

MINIMUM STAFFING OF THE MEDICAL PHYSICS SUPPORT OF NUCLEAR MEDICINE

2.1 Only staff who have had an approved course of training in radiation physics related to nuclear medicine should be included in the minimum staffing level of qualified medical physicist.

2.2 In all departments there must be at least one medical physicist who is qualified and with experience in nuclear medicine physics. If the department has responsibilities related to therapy with radionuclides a second qualified medical physicist may be necessary.

2.3 Minimum staffing levels should be calculated from factors depending both on equipment load and patients examined or treated.

General guidelines are given below (WTE = whole time equivalent) for assessment of minimum medical physics staffing levels for routine clinical work in nuclear medicine

Subject	Total Staff (WTE)	Minimum number of qualified medical physicists within total staff (WTE)
Gamma Camera	0.13	0.06
Non imaging measurement system (including RIA)	0.08	0.04
Computerized analysis system	0.23	0.11
1000 dynamic or SPECTstudies	0.06	0.03
100 new courses of radionuclide therapy per annum	0.10	0.05

The above WTE's have to be multiplied by the number of subjects and summed to calculate the total number of physics staffing.

2.4 Additional staff are required if the Nuclear Medicine Department has other facilities such as PET, cyclotron, or a whole body counter if physics staff work in the radiopharmacy or if the department is using PACS..

2.5 In some european countries medical physicists have a much greater involvement in the management, leadership and development of Nuclear Medicine services; they may have a consultative role in advising medical colleagues of the studies and techniques available and may assist in the presentation and interpretation of results. These aspects of the work are not covered in this document.

MINIMUM STAFFING OF THE MEDICAL PHYSICS SUPPORT OF DIAGNOSTIC RADIOLOGY

3.1 Only staff who have had an approved course of training in radiation physics related to diagnostic radiology should be included in the minimum staffing level of qualified medical physicists.

3.2 All departments using complex equipment or carrying out complex radiological procedures should have available to them the services of at least one medical physicist with experience in diagnostic radiological physics.

3.3 The number of physicists needed will very much depend on the quality assurance programme performed in the department, the involvement of radiographers or other staff in that programme and the involvement of the manufacturer.

3.4 The revised Patient Directive [3)] refers for the first time to the involvement of the Medical Physics Expert in departments of Diagnostic Radiology. The full implications of this, especially in the optimization process, cannot be quantified at this time. It will depend to some extent on the legislation introduced in the member states and must be reviewed at a later date.

3.5 Physics input to diagnostic imaging technique using nonionizing radiation is not considered.

General guidelines are given below (WTE = whole time equivalent) for assessment of minimum medical physics staffing levels for routine clinical work in diagnostic radiology.

Subject	Total staff (WTE)	Minimum number of qualified medical physicists within total staff (WTE)
Radiographic and/or image intensification workstation	0.05	0.01
Film processor or laser imager	0.06	0.01

The above WTE's have to be multiplied by the number of subjects and summed to calculate the total number of physics staffing.

MINIMUM STAFFING OF THE MEDICAL PHYSICS SUPPORT OF RADIATION PROTECTION

4.1 Only staff who have had an approved course of training in radiation physics related to radiation protection should be included in the minimum staffing level of qualified medical physicists.

4.2 The responsibilities covers general protection aspects against ionising radiation in a hospital such as dose monitoring of entire staff and structural protection.

4.3 Additional staff will be needed if the Medical Physics Department has to act as a general radiation protection adviser to the Authority on measures it must take to comply with national regulations and has to advise on other health and safety matters connected with ionising and non-ionising radiation.

General guidelines are given below (WTE = whole time equivalent) for assessment of minimum medical physics staffing levels for routine clinical work in radiation protection.

Subject	Total staff (WTE)	Minimum number of qualified medical physicists within total staff (WTE)
100 person to supervise	0.38	0.15

Appendix I: Catalogue of core tasks in the Medical Physics support of routine clinical work in radiotherapy, nuclear medicine and diagnostic radiology and in radiation protection.

Section A: Radiotherapy.

A.1.: External beam radiotherapy (accelerators, telecurie and orthovoltage units)

A.1.1 Dosimetry, technical verification, and maintenance

1. Calibration of dosemeters (including dosimetric intercomparisons for QA)
2. Calibration of radiation equipment (accelerator dose monitor/timer calibration)
3. Beam data acquisition for treatment planning
4. Measurement of depth dose curves and profiles of the radiation beams according to regulations and guidance
5. Preparation of dose tables for treatment
6. Development/improvement of dose measurement systems and protocols
7. Preparation of software for dosimetry purposes (including spreadsheets and databases)

A.1.2 Treatment units: Machine tests, organisation or preventive/corrective - maintenance

1. Acceptance testing of new machines (taken account of nominal life)
2. Acceptance testing after corrective maintenance
3. Quality control of machine according to regulations and guidance: parameters relevant for treatment, dosimetry and safety devices.
4. Supervision during operation (problem solving, fault indications, emergency stops)
5. Organisation (possibly including carrying out) of scheduled and unscheduled maintenance in order to ensure patient operation is as smooth as possible.

A.1.3 Tasks arising from individual patients

1. Treatment planning (physics component)
2. Initial patient set-up for new treatment plan
3. Verification of machine parameters for every patient during radiotherapy including portal film
4. Patient dose verification (in vivo dosimetry)
5. Daily check of treatment record
6. Preparation of a dose summary at the end of treatment
7. Preparation of individual shielding blocks (for example, large field irradiation)
8. Preparation of individual immobilisation devices
9. Supervision of procedures and documentation of patient treatment according to regulations
10. Regular, at least weekly verification of all treatment files

A.1.4 Treatment planning tasks common to all patients

1. Regular verification of planning system (e.g. monthly)
2. Software management of planning system (e.g. new releases)
3. Quality control of auxiliary equipment used for planning (contouring devices, CT, Simulator etc)
4. Standardisation of therapy procedures
5. Development and optimisation of treatment techniques (including background reading)
6. Measurement on anthropomorphic phantoms
7. Technical improvements (patient couch, laser, digital display, immobilisation devices)
8. Quality control of data transfer, eg. to verify - and - record system

A.1.5 Special radiation protection tasks

1. Co-operation in the planning of new radiation facilities (take account of lifetime)
2. Preparation and revision of local rules
3. Co-operation with fire service. Development of emergency plans.

A.2 Brachytherapy (Use of sealed radioactive materials for intracavitary and interstitial therapy such as for implantation) .

A2.1 Dosimetry, technical verification and maintenance (remote afterloading)

1. Calibration of dosimetry equipment
2. Dosimetry following source change
3. Measurement of dose distribution for proposed source configurations
4. Development/improvement of dosimetry systems (including background reading)

A.2.2 Supervision, organisation of preventive and corrective maintenance (remote afterl.)

1. Acceptance testing of new machines (take account of nominal life)
2. Acceptance testing after corrective maintenance and source changes
3. Regular functional testing according to regulations and guidance
4. Supervision of operation (problem solving, error indications, emergency stops)
5. Management of maintenance and source changes

A.2.3 Manual techniques

1. Dosimetry of new sources
2. Preparation of sources (e.g. source trains, wire cutting)
3. Design of individual applicators

A.2.4 Tasks arising from individual patients

1. Treatment planning (physical component)
2. Support for insertion of sources
3. Verification of source location by means of X-ray films etc.
4. Calculation of the dose distribution resulting from the achieved placement of sources
5. In vivo dosimetry
6. Supervision of radioactive sterilisation (seeds)

A.2.5 Treatment planning tasks common to all patients

1. Regular verification of treatment planning system according to regulations
2. Management of planning software (new releases)
3. Preparation of standard treatment plans
4. Development and optimisation of treatment techniques
5. Development and improvements of treatment aids, shielding blocks, applicators etc. (including background reading).

A.2.6 Special radiation protection tasks in excess of section D of this list

1. Leak testing of sealed sources
2. Storage of radioactive materials
3. Radiation protection measurements on patient phantoms with implanted sources
4. Co-operation with fire service - development of emergency plans
5. Continuous report of radioactive materials stock to the authorities according to regulations.

A.3 General Duties

1. Education and Training (medical physics and radiotherapy staff)
2. Collaboration in procurement of equipment and systems
3. Administration (personnel, purchasing, etc.)
4. Department meetings

Section B: Nuclear Medicine including RIA Laboratory

B.1 Functional check of equipment and materials, quality testing

1. Regular checks of devices (cameras, tomographic devices, counters, activitymeters---)
2. Calibration, for example, procedure of determining renal clearance
3. Quality control of radionuclide generators
4. Acceptance testing of new equipment
5. Organisation of preventive and corrective maintenance
6. Regular quality control of all equipment
7. Calibration, efficiency determination of measuring equipment and RIA procedures

B.2 Methods of Measurement and Evaluation

1. Development and improvement of methods for measurement and evaluation (including background reading)
2. In-process quality assurance
3. Computer software development (diagnostic functions, RIA Lab, PCs)
4. Computer software maintenance
5. Development and standardisation of investigations and evaluation procedures
6. Dose calculation for radionuclide therapy

B.3 Tasks arising from diagnostic procedures in individual patients

1. Participation in investigation/evaluation (SPECT, dynamic studies)

B.4 Special radiation protection duties in excess of section D of this list

1. Leak testing of sealed sources
2. Storage of radioactive materials
3. Storage of radioactive waste
4. Supervision of release of radioactive materials to the environment
5. Verification and improvement of working procedures in order to minimize the radiation load to the employees (including management of accidents)
6. Co-operation with fire service - emergency plans
7. Doserate measurements on radionuclide therapy patients
8. Supervision of liquid waste collection and decay tank
9. Radiation protection in patient's rooms

B.5 Tasks arising from procurement of radioactive materials and removal of radioactive waste

1. Planning of storage and disposal of radioactive waste
2. Purchase of radioactive materials taking account of authorised storage, quantity and time limits, possible radiation exposure, cost etc. including negotiations with the supplier.
3. Demonstration of cost efficiency of new in vitro tests introduced into the RIA laboratory
4. Detailed analysis of costs for radioactive material

B.6 General Duties

1. Education and Training (medical physics and nuclear medicine staff)
2. Collaboration in procurement of equipment and systems
3. Administration (personnel, purchasing, etc.)
4. Department meetings

Section C: Diagnostic Radiology

C.1 Quality Assurance (radiographic equipment including CT and DSA)

1. Film processors: acceptance testing and regular constancy checks according to regulations and guidance
2. Acceptance testing of X-ray equipment and image receptors according to regulations and guidance
3. Regular constancy testing of X-ray equipment according to regulations and guidance
4. Development of new test methods

C.2 Data processing in diagnostic radiology

1. Software maintenance CT, DSA, digital systems
2. Software development

C.3 Supervision of Equipment, maintenance, repair

1. Organisaion of preventive/corrective maintenance
2. Calibration of area dosemeters, TL-dosemeters and radiation protection instruments

C.4 Additional tasks including special radiation protection duties exceeding those in section D of this list

1. Determination of organ doses to patients, fetal doses, radiation doses burden for research work
2. Participation in development and improvement of image quality and optimization in X-ray procedures

C.5 General Duties

1. Education and Training (medical physics and diagnostic radiology staff)
2. Collaboration in procurement of equipment and systems
3. Administration (personnel, purchasing, etc.)
4. Department meetings

Section D: Radiation Protection (General protection against ionising radiation)

D.1 Dose monitoring of entire staff

1. Personal dosimeters (film, etc.) and workplace dose monitoring
2. Radiation protection advice
3. Observation of conduct of medical investigations
4. Supervision of incorporation measurements according to regulations and guidance
5. Calibration of radiation monitoring instruments

D.2 Structural Protection

1. Radiation protection plans for new installations
2. Radiation protection measurements

D.3 Organisational Radiation Protection

1. Monitoring of work practices in order to improve protection
2. Advice to medical practioners and general public
3. Represend the employer in relations with authorities, approval laboratories and standards institutions
4. Organisation of training in compliance with legal requirements and/or good practice

D.4 Equipment and procedure-related radiation protection tasks are also found in the following sections of the list

1. Teletherapy (A.1.5)
2. Intracavitary Radiotherapy (A.2.6)
3. Nuclear Medicine (B.4)
4. Diagnostic Radiology (C.4)

Appendix II: Assesment of staffing levels for medical physics support of:

– **Radiotherapy**

A hospital with:	Needed	Total staff	Including Qualified Medical Physicist
4 Linacs	4 x 0.88	3.52	1.48
1 Cobalt	1 x 0.34	0.34	0.14
1 Conv. X-ray	1 x 0.07	0.07	0.03
2 Afterloading	2 x 0.42	0.84	0.36
1 Simulator	1 x 0.30	0.30	0.13
1 CT	1 x 0.30	0.30	0.13
2 Treatemnt planning systems (ext. beam)	2 x 0.38	0.76	0.32
1 treatment planning system (brachyterapy)	1 x 0.08	0.08	0.04
2000 patients for external beam therapy	20 x 0.27	5.40	2.20
400 patients for brachyterapy	4 x 0.22	0.88	0.36
	Total	12.49	5.19

– **Nuclear Medicine**

A hospital with:	Needed	Total Staff	Including Qualified Medical Physicist
3 Gamma Cameras	3 x 0.13	0.39	0.18
4 Non imaging measurement systems	4 x 0.08	0.32	0.16
2 Computerized analysis systems	2 x 0.23	0.46	0.22
7500 dynamic and SPECT studies	7,5 x 0,06	0.45	0.23
140 new courses of radionuclide therapy	1,4 x 0,10	0.14	0.07
	Total	1.76	0.86

– **Diagnostic Radiology**

A hospital with:	Needed	Total Staff	Including Qualified Medical Physicist
37 Radiographic and image workstations.	37 x 0,05	1.85	0.37
12 Film processors and laser imagers	12 x 0,06	0.72	0.12
	Total	1.33	0.49

– **Radiation Protection**

For supervision of 450 persons working in relation to ionising radiation in a hosptial is needed: 4,5 x 0,38 = 1,7 total staff including 0,68 qualified medical physicist.