Physica Medica (2008) **24**, 3–20

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ORIGINAL PAPER

The present status of Medical Physics Education and Training in Europe: An EFOMP survey☆

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Received 24 August 2007; received in revised form 24 September 2007; accepted 27 September 2007
Available online 3 December 2007

KEYWORDS
EFOMP;
Medical Physics;
Education and training;
Continuing Professional Development (CPD);
Register of professionals

Summary The aim of this work is to present the results of an EFOMP's survey on the status of Education and Training of Medical Physics in Europe. This survey has been undertaken by EFOMP in 2005, to update the document ''Policy Statement No. 1'', which represents the starting point of the EFOMP recommendations on Education and Training in Medical Physics. Ultimate results have been collected at the end of 2006.

To perform the survey, a questionnaire was sent to 34 National Member Organisations (NMOs) for Medical Physics, to collect information on the present state of education and training in each European country. Twenty-five countries participated in the enquiry and responded to it.

Abbreviations: BHPA, Belgian Hospital Physicists Association; BIMEF, Society of Biomedical Engineering and Medical Physics (Serbia-Montenegro); BMGF, Ministry for Health and Women (Austria); BSc, Bachelor's degree; CEM, Centre of Medical Examination (Poland); CMKP, Medical Centre for Postgraduate Education (Poland); CPD, Continuing Professional Development; DIPEM, Diploma of IPEM; DGMP, ''*Deutsche Gesellschaft für Medizinische Physik*'' (German Society of Medical Physics); DQPRM, ''*Diplôme de Qualification en Physique Radiologique et Medicale*'' (Radiological Physics qualifying diploma) Official French Diploma allowing to work as Medical Physicist; DSMF, *Dansk Selskab for Medicinsk Fysik* (Danish Society for Medical Physics); EFOMP, European Federation of Organisations for Medical Physics; EU, European Union; FANC, Federal Agency for Nuclear Control (Official Body in Belgium); HAMP, Hellenic Association of Medical Physicists (Greece); IPEM, Institute of Physics and Engineering in Medicine (United Kingdom); MED, Medical Exposure Directive: Council Directive 97/43/Euratom of 30 June 1997 on health protection of individuals against the dangers of ionising radiation in relation to medical exposure, repealing Directive 84/466/Euratom; MIPEM, Corporate membership of IPEM; MP, Medical Physicist; MPE, Medical Physics Expert (definition given in the MED); MSc, Master's degree; NMO, The National Organisation for Medical Physics of each country member of EFOMP; OeGMP, ''*Österreichische Gesellschaft für Medizinische Physik*'' (Austrian Society for Medical Physics); PhD, Doctor of Philosophy; PS, Policy Statement (EFOMP's document); QMP, Qualified Medical Physicist (EFOMP definition, Policy Statement no. 10); SEFM, ''*Sociedad Española de Física Médica*'' (Spanish Society of Medical Physics); SFPM, ''*Societé Française de Physique Medicale*'' (French Society of Medical Physics); SPM, Specialist Medical Physicist (EFOMP definition, Policy Statement no. 10); U.K., United Kingdom.

☆ All EFOMP Policy Statements can be downloaded from the EFOMP web site: http://www.efomp.org.

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doi:10.1016/j.ejmp.2007.09.022

The most outstanding results are as follows:
- In all countries, the basic requirement to enter the Medical Physics education is a university degree. The length of this university education ranges from 2 to 5 years.
- Concerning the Post-graduate education in Medical Physics:
  - A nationally approved educational programme is in operation in 16 of the 25 countries.
  - Postgraduate education takes place essentially within 3 different approaches and the total length of Medical Physics education and training ranges from 2½ years to 9 years.
- In 14 countries, it is mandatory to hold a diploma or license to work as a Medical Physicist. It allows working in all areas of competence (the most mentioned were Radiotherapy, Nuclear Medicine, Diagnostic Radiology and Radiation Protection) in 14 countries, whereas in 4 countries it allows to work only in 1 or 2 areas.
- Seventeen countries have a register for Medical Physicists.
- A formal CPD (Continuing Professional Development) programme is in operation in 13 countries.
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Introduction

Since its inauguration during the second conference of representatives from European organisations for Medical Physics in London in May 1980, one of the main objectives of the European Federation of Organisations for Medical Physics (EFOMP) has been to harmonise and promote the best practice of Medical Physics in Europe.

To achieve this goal, EFOMP has produced a number of unanimously adopted documents called ''Policy Statements'', making recommendations on the appropriate general responsibilities and roles of the Medical Physicist and proposing guidelines for Education, Training and Accreditation Programmes in Medical Physics. The most recent objectives of the EFOMP documents have been recommendations to implement Continuing Professional Development for Medical Physicists, and Guidelines on Professional Conduct. The total number of Policy Statements to date is 11.

The first of these documents, Policy Statement No. 1 [1] was published at a very early stage, in 1984. It was entitled: ''Medical Physics Education and Training: The present European level and recommendations for its future development'', and it represents the starting point of the EFOMP recommendations on Education and Training in Medical Physics.

To produce the document, it was necessary to be informed about the current state of development of Education and Training in Medical Physics in each European country. For this purpose, two fact-finding inquiries were conducted, as a result of which 19 national organisations for Medical Physics described the current level of education and training in their individual countries.

The results of the inquiry, summarised in the document, provide a global view of the situation on Education and Training in Medical Physics at that time in Europe.

The first EFOMP recommendations on the schemes of Education and Training in Medical Physics and on the education programmes contents were based on these.

Today, more than twenty years later, the content of this Policy Statement No. 1 is obviously obsolete. The organisation of the Medical Physics Education and Training in many countries has changed, and more recent EFOMP Policy Statements have been issued that have introduced new concepts and new recommendations that makes thorough revision of this first document necessary.

For example, reference should be made to Policy statements No. 6 [2]: ''Recommended Guidelines of National Registration Schemes for Medical Physicists'', and Policy Statements No. 8 [3] and No. 10 [4] on Continuing Professional Development for Medical Physicists. In addition, in 1991 EFOMP issued Policy Statement No. 4 on the numbers of qualified physicists needed in a Medical Physics Department. This document was revised in 1997 and published as Policy Statement No. 7 [5]. In 1993, the Policy Statement No. 5 [6] described the advantages, organisation and management of Departments of Medical Physics.

Furthermore, over the last two decades, the Council of the European Union has adopted new Directives on Medical Exposures and EFOMP has issued a series of relevant Policy Statements as a response to this new Legislation. In 1988 EFOMP issued Policy Statement No. 3 [7]: ''Radiation Protection of the Patient in Europe. Training of the Medical Physicist as a Qualified Expert in Radiophysics'' which was the EFOMP response to the Directive 84/466/Euratom [8]. In 1999, the Policy Statement No. 9 [9]: ''Radiation Protection of the Patient in Europe: The Training of the Medical Physics Expert in Radiation Physics or Radiation Technology''. This Policy Statement constitutes the EFOMP response to the Medical Exposure Directive, Council Directive 97/43/Euratom of 30 June 1997 on health protection of individuals against the dangers of ionising radiation in relation to medical exposure, and repealing Directive 84/466/Euratom [10].

A complete revision of the document now therefore appears to be essential. The aim of this work is to provide an updated view of the present level of education and training in Medical Physics in Europe.

Materials and methods

As was done for Policy statement No. 1, the first part of the work consists of collecting the necessary information. To do this in an efficient way, the first task of the working group has been to prepare a questionnaire and send it to the National Organisation for Medical Physics of each country member of EFOMP (NMO). The questionnaire was sent to the Presidents of 34 National Organisations for Medical Physics.

The questionnaire

The questionnaire was structured on a three different parts and the questions were asked in the following subjects:
Part A: Medical Physics education

1. Education requirements to enter the Medical Physics education:
   - What degree is required? It is a university degree? How many years of studies does it represent?
2. Degree on Medical Physics:
   - Is there a nationally approved education programme? Is it official? Who has approved it?
   - Does it lead to any ''official diploma/qualification''? Name of this diploma/qualification in native language and in English.
   - Is the training programme the same in all centres of education in the country?
   - Where do the education and training take place? (University, Hospital, both)?
   - How long is the programme? (Specify the total time spent in each place)
   - What is the process for assessing the training?
   - Are the centres accredited? Who gives the accreditation?
   - Does the programme include the use of EMERALD[1] material as a support?

Part B: Qualified/Specialist Medical Physicist

- Is a ''diploma'' or ''licence'' required to be allowed to act as Medical Physicist?
- Who delivers it? Is it official? (i.e. provided by the government).
- Is it the only way to be eligible for the job? Describe the other possibilities if they exist.
- Does the ''diploma'' or ''licence'' allow a person to act as a *Medical Physics Expert* (MED Directive) in the country?
- Is the ''diploma'' or ''licence'' equivalent to *Qualified Medical Physicist*[2] *(QMP)* or to *Specialist Medical Physicist*[3] *(SMP)* (EFOMP definitions)?
- List the areas of competence in which this ''diploma'' or ''licence'' allows one to work.

Part C: Registration

1. General information:
   - Is there a Register of Professionals in the country?
   - Is it officially recognised by the authorities in some way? Who is in charge of it?
   - Is the Register entrance voluntary or compulsory based?
   - How many registrants do you have? What fraction of practising Medical Physicists does it represent?
   - What fraction of applicants has been refused, on what bases?. If the Register is compulsory, what is the consequence of a refused registration?
   - What proportion of your registrants has passed through a recognised training scheme and what proportion was accepted because they were already working in medical physics? What criteria were used to include the later group?
   - Does the Register identify 2 levels of registrants QMP and SMP?
   - Does the Register have a special procedure for including applicants from a foreign country, registered on a foreign approved register?
2. Registration Council:
   - Give the names and functions of the registration council members.
3. Continuing Professional Development (CPD):
   - Is there a renewal mechanism in the Register?
   - Is it based on a CPD system, as described in EFOMP Policy Statement N. 10?
   - How does it comply with EFOMP Policy Statement N. 10?

Results

The following 25 countries participated in the enquiry and responded to it: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, The Netherlands, Norway, Poland, Portugal, Russia, Serbia-Montenegro, Spain, Sweden, Turkey and United Kingdom.

The results can be summarised as follows.

Part A: Medical Physics Education

In all countries, the basic educational requirement to enter Medical Physics is a university degree, but this is not uniform. Different NMOs refers to it as: Diploma, Degree, First Degree, BSc, MSc, or other. It may be in the field of: Natural Sciences, Physics, Chemistry, Engineering, or similar. The total duration of these studies ranges from 1½ years to 5 years at a university.

Fig. 1 shows the percentage distribution for the type of basic university degree required to enter Medical Physics education in the 25 countries. The duration of the studies in most countries included in ''others'' is at least 4 years.

Concerning post-graduate education in Medical Physics, in 16 of the 25 countries there is a nationally approved education programme. The programme's approval is granted solely by the Ministry of Education or by the

[1] EMERALD: European MEdical RAdiation Learning Development is a set of e-learning material that have been developed under the EC Leonardo da Vinci program, jointly with the EMIT (European Medical Imaging Technology Training) project. Both projects have been supported by EFOMP. Further information: http://www.emerald2.net.

[2] The Qualified Medical Physicist (QMP) is competent to act independently, and has the minimum qualifications required for enrolment in an EFOMP approved National Register for Medical Physicists. Recognition as a Qualified Medical Physicist is achieved only after completion of a basic university education in physical sciences, engineering or equivalent, followed by a further 2–4 years theoretical education and practical training in Medical Physics (depending on the national education system) under supervision of a Qualified Medical Physicist, preferably a Specialist Medical Physicist.

[3] The Specialist Medical Physicist (SMP): The Qualified Medical Physicist qualifies to become a Specialist Medical Physicist by gaining advanced clinical experience and undergoing specialist training of at least two further years duration, mostly in one sub-speciality, within the first period of an EFOMP approved National CPD Scheme. The Specialist Medical Physicist is competent to give advice on all professional matters in their sub-speciality. Within the EU, as defined in the Medical Exposure Directive [10] ''in relation to medical exposure'', the Medical Physics Expert is equivalent to the Specialist Medical Physicist.

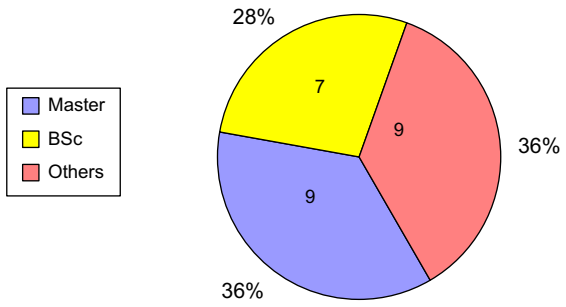


Figure 1 Percentage distribution of the type of basic university degree required to enter Medical Physics education in the 25 countries.

Committee of Universities in the following countries: Finland, Greece, Latvia and Poland, whereas in Austria, Croatia, the Czech Republic, Denmark, France, Italy, The Netherlands, Spain, Sweden and the U.K., the Ministry of Health is also involved in the approval. Germany has educational programs approved only by their own National Organisation for Medical Physics, although it is presently involved in the process of obtaining government recognition (Fig. 2).

In Austria, Denmark and the U.K. the Ministry of Health approves the educational programme, but the specific programme is run by the National Society of Medical Physics (OeGMP, DSMF and IPEM respectively). In Belgium, the programme is approved by the Federal Agency for Nuclear Control (Fig. 2).

Finally, 9 countries (Bulgaria, Cyprus, Hungary, Ireland, Norway, Portugal, Russia, Serbia-Montenegro and Turkey) do not yet have a nationally approved programme for Education and Training in Medical Physics, or have no regulated programme at all.

Post-graduate education is essentially provided in three ways. First, the university approach, leading to a Masters degree and/or Ph.D. degree in Medical Physics. This is the case for Czech Republic, Finland, Serbia-Montenegro, and Turkey. The problem in this approach is that the skills of clinical practice may not be well guaranteed because of the little time spent in hospitals: in some cases, ''1 or 2 weeks'' or ''summer practice''.

The second approach is solely within the framework of professional practice. This is the case for Denmark, Norway and Spain. In these countries, the time required is at least of 3 years. With this approach, additional courses are needed to complete the education.

Finally, the third way, the most common, combines University and Hospital training. In this approach, post-graduate education ranges from 1 year (Latvia and Bulgaria) to 5 years in Germany. Fig. 3 shows the percentage distribution of the different ways post-graduate education in Medical Physics is conducted in the different countries. In A) looking at the total group of 25 countries, and in B) looking at the 16 countries with nationally approved programme.

Fig. 4 shows the duration of the post-graduate training for the 16 countries with a nationally-approved programme. This figure shows that post-graduate training in two countries is given only at the university, and in two other countries, the post-graduate training is done only ''on the job'' at the hospital. For the remaining countries, the training consist of a combination of university study and hospital practice.

Regarding the total length of the education and training to become a Medical Physicist, it ranges from 2½ years for Bulgaria to 9 years for Italy, Croatia and The Netherlands. The time spent in the different countries is detailed in Table 1, Appendix I.

Fig. 5 shows the length of the total training to become Medical Physicist in the 16 countries with nationally approved program. From the figure, it can be seen that the total length of the education and training to become a Medical Physicist ranges from 4½ years for Sweden to 9 years for Croatia, Italy and The Netherlands. The mean value is 7 years.

More details on education and training for the 25 countries are listed in Table 1, Appendix I.

Concerning accreditation of the centres where the education takes place:

In 8 countries (Denmark, Greece, Italy, Latvia, Poland, Serbia-Montenegro, Spain and Turkey) an official body (Ministry of Education, Ministry of Health, or other governmental agency) accredits them.

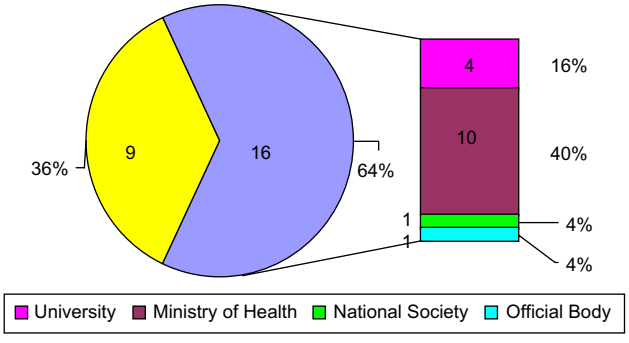


Figure 2 Percentage distribution of the official bodies that approve the post-graduate educational programmes in the 16 countries: Universities, Ministries of Health, National Societies of Medical Physics and other official entities.

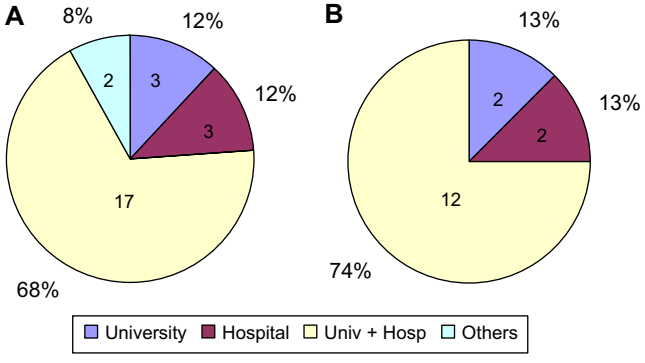


Figure 3 Percentage distribution of the different ways post-graduate education in Medical physics is conducted in the different countries. (A) For the total group of 25 countries. (B) For the 16 countries with nationally approved programme.

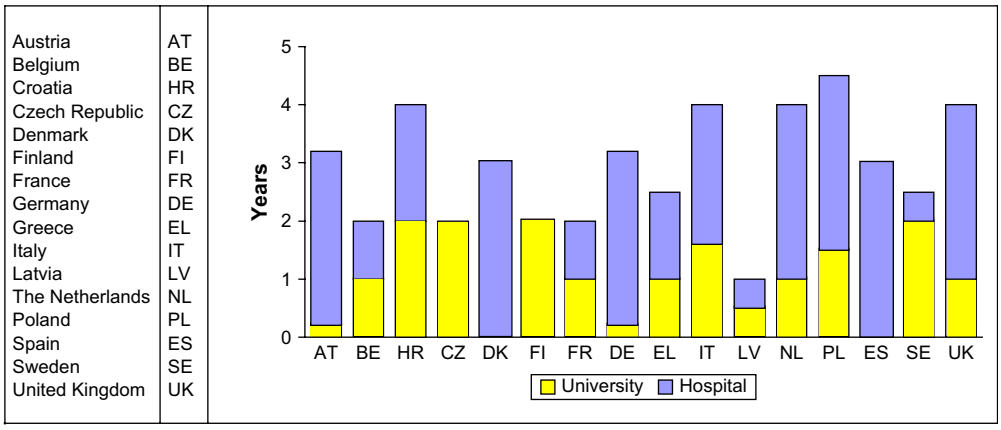


Figure 4 Duration (in years) of the post-graduate training for the 16 countries with a nationally approved programme. The figure shows the time spent at the university and the time spent at the hospital.

For Austria, France, Germany, The Netherlands and U.K., the accreditation is granted by their own National Organisation for Medical Physics. In Ireland the accreditation is given by the IPEM (Institute of Physics and Engineering in Medicine).

Finally, there are some countries which have no type of accreditation of the educational centres. This is the case of Belgium, Bulgaria, Croatia, the Czech Republic, Finland, Hungary, Norway and Sweden.

The process for assessing training differs depending on the approach in which the post-graduate education is done. When it is based solely within the framework of professional practice, evaluation is made mainly by the assessment of the supervisor, based on periodical reports from the candidate. In the other approaches, the most common way used is a final examination.

Completion of the educational programme leads to a diploma or some qualification in 18 of the 25 countries. It should be noticed that the name of this diploma or qualification is different in each one of them:

- Austria: MSc in Medical Physics
- Belgium: Acknowledged expert in Medical Physics
- Croatia: 1. degree: Master of Medical Physics/2; degree: Specialist Medical Physicist
- Czech Republic: Professional qualification for pursuing the health profession of radiological physicist
- Denmark: Medical Physicist in Diagnostic Radiology; Medical Physicist in Radiation Therapy; Medical Physicist in Nuclear Medicine
- Finland: Phil.-Lic (or PhD) with the degree of Qualified Medical Physicist
- France: Medical and Radiological Physics qualifying diploma (DQPRM)
- Germany: Registration certificate
- Greece: Post-graduate diploma in Medical Physics (M. of Sc. In Medical Physics)
- Hungary: MSc in Biomedical Engineering (Direction Medical Physics)
- Italy: Medical Physics Specialist
- Latvia: Professional Master degree in Medical Physics
- The Netherlands: *Clinical Physicist*
- Poland: Specialist in Medical Physics
- Serbia-Montenegro: Specialist in Medical Physics
- Spain: Specialist in Hospital Radiation Physics
- Sweden: Hospital Physicist degree
- United Kingdom: Diploma of IPEM (DIPEM)/Corporate membership of IPEM (MIPEM)

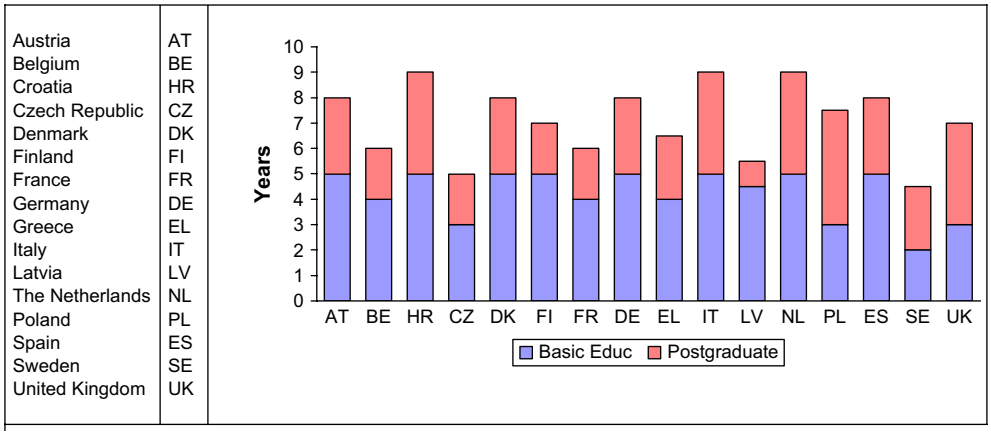


Figure 5 Duration (in years) of total training to become a Medical Physicist in the 16 countries with a nationally-approved programme. The two parts of training: basic education and post-graduate education, are clearly identified in the figure.

The ''EMERALD'' material is used as a support in the educational programmes in Bulgaria, Denmark, France, Greece, Ireland, Latvia, Norway (only for Radiotherapy), Poland, Portugal (only in some hospitals) and Turkey. However, this material is still unknown in some other countries.

Table 1 in the Appendix I summarises the results of part A of the questionnaire.

Part B: Qualified/Specialist Medical Physicist

The main goal of this part of the questionnaire was to ascertain the essential requirements needed to work as a Medical Physicist in the different countries, and whether the competencies to work as such, are at the level of Qualified Medical Physicist (QMP) or at the level of Specialist Medical Physicist (SMP), both defined by EFOMP [4].

In 14 countries, it is mandatory to hold a diploma or license to work as a MP: Austria, Bulgaria, Croatia, Cyprus, the Czech Republic, Finland, France, Greece, Italy, The Netherlands, Poland, Portugal, Spain and Sweden. In some others, such as Belgium and Turkey, it is only necessary that one person holds such a diploma or license in each hospital. In Denmark, the license is only necessary to work as ''the responsible MP'', not to work as an ordinary MP. In Germany, it is only compulsory to hold the diploma or license in Berlin. In the U.K. it is mandatory to be registered. In the remaining countries there is no requirement to hold a diploma or license to work as a MP.

The diploma or license is provided by a governmental body (other than the University) in 12 countries: Austria, Belgium, Bulgaria, Cyprus, Denmark, Finland, France, Greece, The Netherlands, Poland, Spain and Sweden). In Germany, this applies for Berlin only.

In most countries, this diploma is obtained after completion of the whole education and training programme described in the previous section. Nevertheless, in some others there are alternative possibilities to obtain it. Such is the case for Finland, Germany and the U.K. where a period of 3—4 years of working experience leads to the same diploma.

In answer to the question: ''Does the diploma or license allow a person to act as a Medical Physics Expert (MPE) as defined in the Directive 97/43/Euratom?'', the results of the survey show this is possible in Austria, Bulgaria (it is one of the requirements), Croatia, Finland, France, Greece, Italy, The Netherlands, Poland, Portugal, Spain, Sweden and Turkey.

It should be noticed that the MPE is not defined yet in several countries. Such is the case for the Czech Republic, Denmark, Hungary and Serbia-Montenegro.

In answer to whether the diploma or licence is equivalent to QMP or to SMP (EFOMP definitions), the results showed: in Austria, Belgium, Croatia, Denmark, France and Greece, the diploma/license allows to work at the level of QMP, whereas in Bulgaria, Germany, Italy, The Netherlands, Poland, Serbia-Montenegro, and Spain it is equivalent to SMP.

Finally, the areas of competence in which this diploma or licence allows physicists to work differ considerably depending on the country. The most commonly mentioned are Radiotherapy, Diagnostic Radiology and Nuclear Medicine. In the majority of countries, this diploma/license allows Medical Physicists to work in all areas of competencies. In some other countries however, such as Belgium, Denmark, Germany and the Netherlands, the education and training are specific only for one area, so Medical Physicists are allowed to work only in one (or two) of the mentioned areas, depending on the initial choice. Fig. 6 shows these results.

The non-ionising radiation field is also considered competence of Medical Physicists in Bulgaria (for Specialists in Medical Health Physics only), Croatia, Italy, Poland, Sweden and the U.K.

Radiation Protection is a field of competence only in Croatia, Greece, Italy, Latvia, Spain and, in some institutions only, Sweden. In Bulgaria it is competence of Medical Physicists only in the field of Radiotherapy.

On that issue, the EFOMP Council has approved very recently the document ''Malaga Declaration'' [11] on EFOMP's position on the Medical Physics in Europe. Point 3 of this document, which is dealing with Medical Physics in Radiation Protection in the Medical Area, clearly states that Radiation Protection in hospitals, involving patients, working staff and members of the public, must be performed by Medical Physics Experts.

In Finland, Medical Physicists also have competencies in Clinical Physiology and in Clinical Neurophysiology, and in the Netherlands in the area of Audiology.

Table 2, Appendix I, summarises the results of part B of the questionnaire.

Part C: Registration

At present, 17 countries have a Register of Professionals working as Medical Physicists: Austria, Belgium, Bulgaria, Croatia, the Czech Republic, Denmark, Finland, France, Germany, Greece, Ireland, Latvia, Netherlands, Poland, Spain, Sweden and the U.K.

The Register is ''official'', in the sense that it is recognised and managed by a governmental body (Ministry of Health, National Board of Health, etc.) in 10 countries: Austria, Belgium, Bulgaria, the Czech Republic, Finland, The Netherlands, Poland, Spain, Sweden and the U.K. For the remainder, it is the National Organisation for Medical Physics who manages the Register by means of their own Registration Board.

Austria, Belgium, Bulgaria, Spain and Sweden have two different kinds of Registers: in addition to the ''official'' register managed by the authorities, the National Society

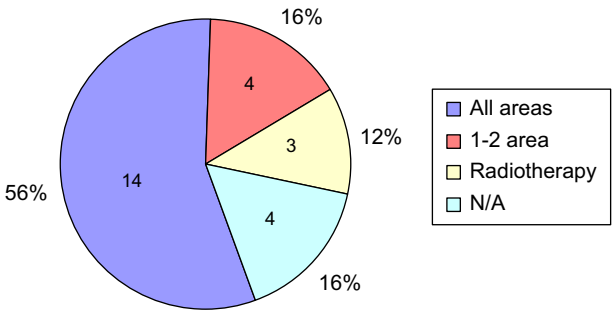


Figure 6 Distribution of the areas of competence in which the Medical Physics graduate is qualified to work, in the 25 countries.

for Medical Physics also has its own register, voluntary-based, whose aim is to better accomplish the EFOMP requirements.

The Register is compulsory in Belgium (the official one), the Czech Republic, Finland, the Netherlands, Sweden and the U.K. In Austria, Bulgaria (the official register), Denmark and Spain (the official register), registration is ''automatic'' in the sense that Medical Physicists are automatically registered when they obtain their diploma. For the remaining countries, the Register is a voluntary one.

The Register identifies two levels (QMP and SMP) only in Bulgaria, Denmark, France and Spain (only for the register managed by the SEFM).

In general, there is no special procedure to include applicants from a foreign country in the National Registers. The most common way consists of an individual assessment of the applicant.

A Continuing Professional Development (CPD) system operates in 13 countries: Austria, Belgium, Croatia, Czech Republic, Denmark, France, Germany, Greece, Ireland, The Netherlands, Spain, Sweden and the U.K.

CPD is used as a renewal mechanism for the Register in all of them, either partially or fully.

The CPD system fully complies with EFOMP recommendations stated in Policy statement No. 10 [4] only in 10 countries (Austria, Belgium, Croatia, Denmark, France, Germany, Greece, Ireland, Spain and the U.K). It is presently in the process of adaptation in the Czech Republic and Sweden.

CPD is based on a 5- or 6-years-cycle time in most countries.

Table 3, Appendix I, summarises the results of part C of the questionnaire.

Conclusions

The most relevant conclusions can be summarised as follows:

- Basic education:
  - In all countries, the basic requirement to enter Medical Physics is a university degree. Master's degree 36%, BSc 28% and the remainder refer to a diploma, a license, first degree, etc.
  - The length of the basic university education ranges from 1½ to 5 years.
- Post-graduate education in Medical Physics:
  - Unfortunately, Medical Physics education is not yet regulated in some countries.
  - A nationally approved educational programme is in operation in 64% of the countries. The university gives approval in 16% of them, whereas in 40% the ministry of health is also involved in the approval. National Societies for Medical Physics having played an important role in setting-up the educational programmes in most countries.
  - There are basically 3 different approaches to post-graduate education:
    a) University studies only, leading to a Master's Degree or PhD in Medical Physics (12% of the overall countries).
    b) Hospital only: on-the-job training (12% of the overall countries).
    c) Combining University + Hospital (68%). In this approach the time spent in the hospital ranges from 1 month to 3 years.
  - The total length of Medical Physics education and training (basic university + post-graduate training) ranges from 2½ years to 9 years.
  - Completion of the educational programme leads to a diploma/license named very differently in each country.
- Diploma or license to work as a Medical Physicist:
  - In 56% of the countries, it is mandatory to hold a diploma or license to work as a Medical Physicist. In 4 countries this is only mandatory for 1 physicist per centre, or only to act as responsible Medical Physicist.
  - This diploma or licence is ''official'' in the sense that it is delivered by a governmental body in 48% of the countries.
  - Holding this diploma/license is the only way to be eligible for the job in 56% of the countries. Other possibilities such as: ''hold a Master's degree'' or ''3 years' work experience'', are also possible for the remaining countries.
  - It allows one to work as a *Medical Physics Expert (MPE)* in 52% of the countries.
  - It is equivalent to *Qualified Medical Physicist (QMP)*, EFOMP definition, in 24% of the countries.
  - It is equivalent to *Specialist Medical Physicist (SMP)*, EFOMP definition, in 28% of the countries.
  - It allows one to work in all areas of competence in 56% of the countries, whereas in 4 countries (16%) it depends on the areas selected by the Medical Physicist in their education and training programme (only one or two areas per training programme are possible).
- Register of professionals:
  - 68% of the countries have a register for Medical Physicists. In 59% of them, an official body manages the register, whereas in 41% the Board of their own National Society for Medical Physics exclusively does so.
  - The register is compulsory in 35% of the cases and voluntary based in 53%. For the remainder it can be considered ''automatic''.
  - A renewal mechanism is in operation in 65% of the registers.
- Continuous Professional Development (CPD):
  - A formal CPD programme is in operation in 52% of the countries, fully or partially complying with the EFOMP recommendations.
  - CPD is used as a renewal mechanism in the Register in all of them.
  - The CPD cycle time, credit-point based ranges from 5 to 6 years.

Acknowledgments

The authors acknowledge all those that have been made possible this work: The NMO's who has responded to the questionnaire; The EFOMP's Officers who have always supported the initiative and have contributed to the final version of this document with comments, suggestions and even grammar corrections. Finally, a special acknowledgement to Helene Bouscayrol, core member of the EFOMP Standing Committee on Registration, for her valuable contribution in setting up the questionnaire.

Appendix I: Results

Table 1 Summary of the part A of the questionnaire: Medical Physics education and training

Country	Basic education		Post-graduate education on Medical Physics								Total years MP
	University degree	No. years	National approv. Progr.?	Approved by:	Where the Education take place?	Total years	Time Univ.	Time Hosp.	Centres accred.?	By:	Assessment of the training	
Austria	MSc or PhD in Physics, Technical Physics or Electrotechnics	5	Yes	BMGF OeGMP	University + Hospital	3 (min)	360 h + Master Thesis	3 years (min)	Yes	OeGMP	OeGM: MSc Diploma + evidence of experience BMGF: MSc diploma or OeGM certification	8 (min)
Belgium	License in Physical Science, Chemistry, Engineer or equiv.	4—5	Yes	FANC	University + Hospital	2	1	1	No		Examination + Thesis	6—7
Bulgaria	BSc. in Physics or Engineering	1½—2	No		3 Universities + Hospitals	1 or 1.5	90%	10%	Not yet		Examination + Thesis	2½—3½
Croatia	Past: Diploma. Engineer Prof. of Physics Now: Master of Physics	5	Yes	University of Zageb + Ministry of Health	University + Hospital	4	2 Simult. Hosp.	2	Not yet		2 examinations 1: After 2 years (Master) 2: After 4 years (SMP)	9
Cyprus	Master degree in Medical Physics	4—5	No		Abroad							N/A
Czech Republic	BSc. Mathematics and Physics	3	Yes	Ministry Education Ministry of Health	University only	2—3	2—3	No data	N/A		N/A	5—6
Denmark	MSc in Physics, Engineer or equiv.	5	Yes	Ministry of Health. Run by: DSMF	Hospital only	3 (min)	—	3 years (min)	Yes	National Board of Health	Supervisor assessment	8 (min)
Finland	BSc or MSc in Physics, Engineer or equiv.	5	Yes	Ministry Education	University OR Hospital	2—3 or 4	2—3 for PhD	4 on-the-job	No		Final examination	7—8
France	MSc in Physics or related areas (M1)	4	Yes	Min. of Education. Ministry of Health (DQPRM diploma)	University + Hospital	2	1	1	Yes	Education Board of SFPM	Oral + written exam. Continual evaluation by the training team	6
Germany	Diploma/Master Physics or Engineering	3—5	Yes	DGMP only	University + Hospital	5—3	360 h	5—3	Yes	DGMP only	Oral examination	8
Greece	First degree in Physics	4	Yes	Ministry Education	University + Hospital	2½	1	1½	Yes	Ministry of Health	Examinations	6½
Hungary	BSc Physical Science or equiv.	3—3½	Not yet	Ministry Education (only: Master 2 year)	University + Hospital	4	2 (approv)	2 (sugges)	No		N/A	7½ (sugg)
Ireland	B. Sc. (Hons) Physics or equiv.	4	No		University + Hospital	3	1	2	Yes	IPEM	Oral exam. (internal) + Exter. Interview (final)	7

Italy	''Laurea Specialistica: Fisica''	5	Yes	University Minister + Ministry of Health	University + Hospital	4	40%	60%	Yes	Regional Governm.	Examination + final diploma thesis	9
Latvia	Professional BSc in MP Professional BSc or 5th level professional qualifications	4½	Yes	Accredit. Committ. of the Minister of Science and Educat.	University + Hospital	1	½	½	Yes	Accreditt. Com. Min. Scien. Ed	Examination Master thesis	5½
Netherlands	MSc in Physics	5	Yes	Exec. Comm. Board Registration, Dutch Society (From 2005 Government approved)	University + Hospital	4	1	3	Yes	Exec. Com. Registrat Dutch Soc	Final examination and compulsory reports every half year	9
Norway	Master	5	No		Hospital only (working under supervision)	3—5			No		NO	N/A
Poland	Licence in Physics or BSc. in Techn. Physics	3—3½	Yes	University + Ministry of Science	University + Hospital	4½	1½	3	Yes	Ministry of Health	State Exam (Medical Examination Center)	7½—8
Portugal (*)	Degree on Physics or Physics Engineering	4—5	No		Hospital only	2	—	2		Ministry of Health		6—7
Russia	N/A		Not yet									
Serbia-Montenegro	High degree (Natural Science, Electr. Eng, Nuclear Physics)	4	Not yet	Only University	University	1	1	1—2 weeks	Yes	University	Examination	5
Spain	''Licenciatura'' in Physics, Engineering or equiv.	4—5	Yes	Ministry of Health and Ministry of Education	Hospital only	3	—	3	Yes	Ministry of Health	Annual evaluation of the trainee, certified by the Hospital Educat. Comm.	7—8
Sweden	2 years University Maths + Physics	2	Yes	National Body of Health and Welfare	University + Hospital	2½	2	½	No		No data	4½
Turkey	Basic Degree Physical Science or Engineering	4	No	Only University	University	2 (Master) 4 (PhD)	2—4	—	Yes	University	Examinations	6—8
U.K.	BSc (Honours level) in Physics, engineering or allied Science	3—4	Yes	Departm. of Health. Run by IPEM	University + Hospital	2: DIPEM 4: MIPEM	1	1 2	Yes	IPEM	Oral examination of portfolios demonstrating level of competences	5—7

(*) For Portugal, the data showed in this table refers to the training scheme as it was organised until 2003. Since then, the status of public hospitals (who delivered the training) has changed (from public to privat managed organizations). The new man agement-status does not promote the traditional established professional careers (e.g. hospital physics career) implementing, as an alternative, individual work contracts with the employees. Various education programes in medical physics related areas are currently available in Portugal and a proposal for an education program (MSc), to complement the official training, was prepared by two public high education institutions and proposed as a suitable alternative to the established scheme.

List of abbreviations used in this Table: BSc: Bachelor's degree; DSMF: Danish Society for Medical Physics; MSc: Master's degree; SFPM: French Society for Medical Physics; PhD: Philosophical Doctor (Thesis); DQPRM: Official French Diploma allowing to work as Medical Physicist; MP: Medical Physicist; IPEM: Institute of Physics and Engineering in Medicine (United Kingdom); OeGMP: Austrian Society for Medical Physics; DIPEM: Diploma of IPEM (after 2 years training); BMGF: Ministry for Health and Women (Austria); MIPEM: Corporate Membership of IPEM (after 4 years training); FANC: Federal Agency for Nuclear Control (Belgium); DGMP: German Society of Medical Physics.

Table 2 Summary of the part B of the questionnaire: Qualified/Specialist Medical Physicist

Country	Diploma/Licence to act as MP?	Is it official? (Government)	Who delivers it?	Only way for job?	Other possibilities?	Allow to act as MPE?	Equivalent to QMP or to SMP ?	Areas of competence
Austria	Yes: Licence	Yes	BMGF	Yes		Yes	QMP (SMP not defined)	Radiotherapy; Nuclear M; Radiology
Belgium	Only 1 per Hosp. (Radiotherapy)	Yes	FANC	Yes		N/A	QMP	Radiotherapy; Nuclear M; Radiology Only in 1 or 2 areas
Bulgaria	Yes	Yes	Ministry of Health	Yes		It is one of the required conditions	SMP: Spec. Med. Rad. P. Spec. Med. Health Physics.	Spec. in Medical Radiation Physics: Radiotherapy, Nuclear M., Radiology Specialist in Medical Health Physics: Non-ionizing-radiations
Croatia	Yes	No. Only University	University	Will be		Yes	QMP	Radiotherapy; Nuclear M; Radiology; Radiation Protection; Non-Ionizing rad.
Cyprus	Yes	YES	Ministry of Labour	No	All qualified MP can be employed	Depending of the years of experience	Depending of the years of experience	All areas of Medical Physics
Czech Republic	Yes	No. Only University	University	No	Any MSc + courses	MPE not yet defined	N/A	Radiotherapy; Nuclear M; Radiology
Denmark	Only for the: Responsible MP	Yes, only for Responsible MP	National Body of Health	No	To work as an ordinary MP	No. MPE not yet defined	QMP	Only in 1 or 2 areas of specialization: Radiotherapy; Nuclear M; Radiology
Finland	Yes	Yes	University + National Authority Medicolegal	Yes		Yes	N/A	Radiotherapy; Nuclear M; Radiology Clinical Physiol; Clinical Neurophys.
France	Yes (DQPRM)	Yes	INSTIN (University) DQPRM defined by low	Yes		Yes	DQPRM = QMP SMP = after 5 years experience	Radiotherapy; Nuclear M; Radiology
Germany	Only in Berlin	Yes (Berlin only)	The Senat (Berlin only)	No	Personal initiat. or advertising	N/A	SMP	Depend on the areas selected by the MP during his Education & Training
Greece	Yes	Yes	Ministry of Health	Yes		Yes	QMP	Radiotherapy; Nuclear M; Radiology; Radiation Protection
Hungary	No				University Diploma in Phy	No regulation	N/A	N/A
Ireland	Not yet (2008)?	Will be	Will be: State appointed Registration Council	Will be	Only BSc, MSc or PhD Physics	Not yet	N/A	N/A

Italy	Yes	No. Only University	University	Yes		Yes	SMP	Radiotherapy; Nuclear M; Radiology; Radiation Protection; Non-Ionizing rad.
Latvia	No				Master degree on Phys. or MP			Radiotherapy; Nuclear M; Radiology; Radiation Protection
Netherlands	Yes	Yes (2005)	Executive Committ. for Board registration of the Dutch Society (on behalf of the Ministry of Health)	Yes But No in Practice	N/A	Yes	SMP	Only 1 area per training programme: General Clinical Physics; Radiotherapy; Nuclear M; Audiology; Radiology
Norway	No				Get a position and practice for 3—5 years	N/A	N/A	N/A
Poland	Yes	Yes	Head of the Centre of Medical Examination	No	Master degree on Physics	Yes (from 2005)	SMP	Mainly Radiotherapy From 2005: QA in Nuclear Medicine and Radiology Non-Ionizing Radiation
Portugal (*)	Yes	Yes	Ministry of Health	No	Appropriate Curric. Vitae	Yes	N/A	Radiotherapy; Nuclear M; Radiology
Russia	N/A							
Serbia-Montenegro	Not yet (in progress)	N/A	Ministry of Health (will be)	No	Appropriate Univ. Diploma	Not yet	SMP	Radiotherapy (primarily)
Spain	Yes	Yes	Ministry of Education	Yes	Work under supervision	Yes	SMP	Radiotherapy; Nuclear M; Radiology; Radiation Protection
Sweden	Yes	Yes	National Body of Health and Welfare	Yes		Yes	Below QMP	Radiotherapy; Nuclear M; Radiology; Non-Ionizing Radiation
Turkey	At least 1 per Centre	No	Council of Higher Education	No	N/A	Yes	N/A	Radiation Oncology
U.K.	Be registered	Yes (in any way)	IPEM	No	3 years of work	No	QMP	All areas

(*) For Portugal, the data showed in this table are only available until 2003.

List of abbreviations used in this Table: MP: Medical Physicist; BMGF, Ministry for Health and Women (Austria); MPE: Medical Physics Expert (Directive 97/43 Euratom); FANC, Federal Agency for Nuclear Control (Belgium); QMP, Qualified Medical Physicist (EFOMP definition); INSTIN, National Institute for Nuclear Science and Technology (France); SMP, Specialist Medical Physicist (EFOMP definition); DQPRM, Official French Diploma allowing to work as Medical Physicist; MSc, Master's degree; IPEM, Institute of Physics and Engineering in Medicine (United Kingdom); QA, Quality Assurance.

Table 3 Summary of the part C of the questionnaire: Registration and CPD

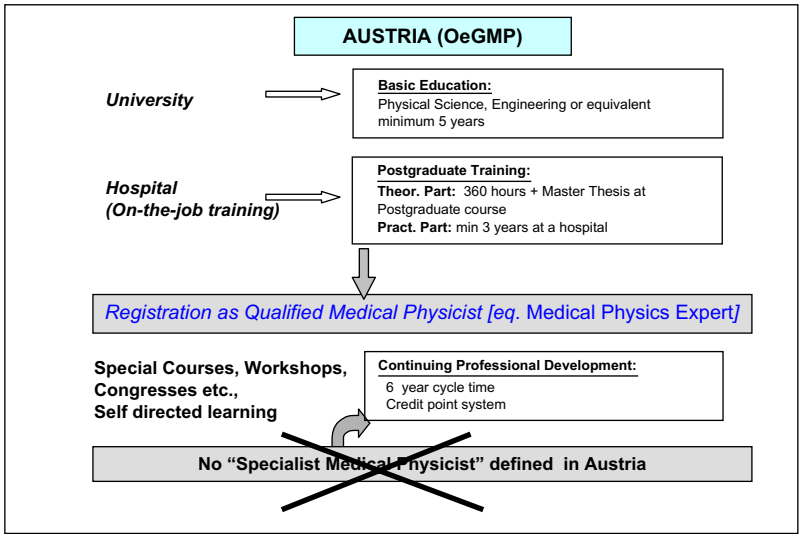
Country	General Information				
	Register?	Officially recognised?	Who is in charge of it?	Voluntary/Compulsory	Haw many registrants?
Austria	Yes (2 differ.)	Yes	OeGMP BMGF	Automatic	50
Belgium	Yes (2 differ.)	FANC: Yes BHPA: No	FANC BHPA	Compulsory Voluntary	No data
Bulgaria	Yes (2 differ.)	Yes	Ministry of Health Profes. Society of Biom. Phys. Engin	Automatic Voluntary	40
Croatia	Yes	No	N/A	N/A	8
Cyprus	No				
Czech Republic	Yes	Yes	Ministry of Health	Compulsory (in 2006)	No data
Denmark	Yes	No	Educat. Committee of DSMF	Automatic	57 MP +36 in training
Finland	Yes	Yes	National Authority Medicolegal Affai.	Compulsory	80
France	Yes	No	Registrat. Committ of SFPM	Voluntary	147
Germany	Yes	No	DGMP	Voluntary	550
Greece	Yes	No	HAMP	Voluntary	203
Hungary	No				
Ireland	Yes	No	Registered Members themselves	Voluntary	39
Italy	No				
Latvia	Yes	No	Latvian Med Engin and Phys Society	Voluntary	30 (only 7 MP)
Netherlands	Yes	Yes	Executive Committ for Board Regist of the Dutch Society	Compulsory	245
Norway	No				
Poland	Yes	Yes	CMKP and CEM + Ministry of Health	Voluntary	20 + 48 (in process)
Portugal	No				
Russia	N/A				
Serbia-Montenegro	No	Not yet	BIMEF + Ministry of Health and Labour	Compulsory (will be)	N/A
Spain	Yes (2 differ.)	1: Yes 2: No	1: Ministry of Health 2: SEFM	Automatic Voluntary	1: 480 2: 160
Sweden	Yes (2 differ.)	Yes	National Body of Health and welfare	Compulsory	300
Turkey	No	No	N/A	N/A	
U.K.	Yes	Yes	Health Professions Council	Compulsory	1260

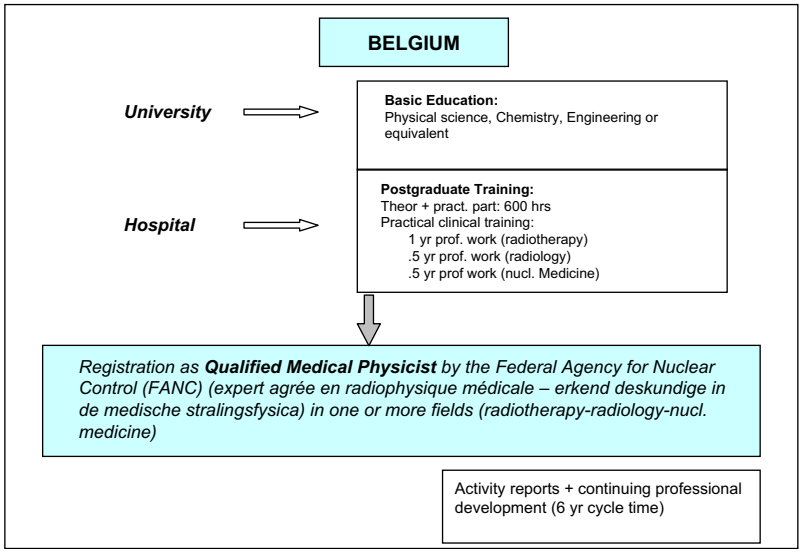
List of abbreviations used in this Table: CPD: Continuous Professional Development; SFPM: French Society for Medical Physics; MP: Medical Physicist; BHPA: Belgian Hospital Physicists Association; QMP: Qualified Medical Physicist (EFOMP definition); DGMP: German Society of Medical Physics; SMP: Specialist Medical Physicist (EFOMP definition); HAMP: Hellenic Association of Medical Physicists; PS: Policy Statement (EFOMP's document); CMKP: Medical Centre for Postgraduate Education (Poland); FANC: Federal Agency for Nuclear Control (Belgium); CEM: Centre of Medical Examination (Poland); OeGMP: Austrian Society for Medical Physics; BIMEF: Society of Biomedical Engineering and Medical Physics (Serbia-Montenegro); BMGF: Ministry for Health and Women (Austria); SEFM: Spanish Society of Medical Physics; DSMF: Danish Society for Medical Physics.

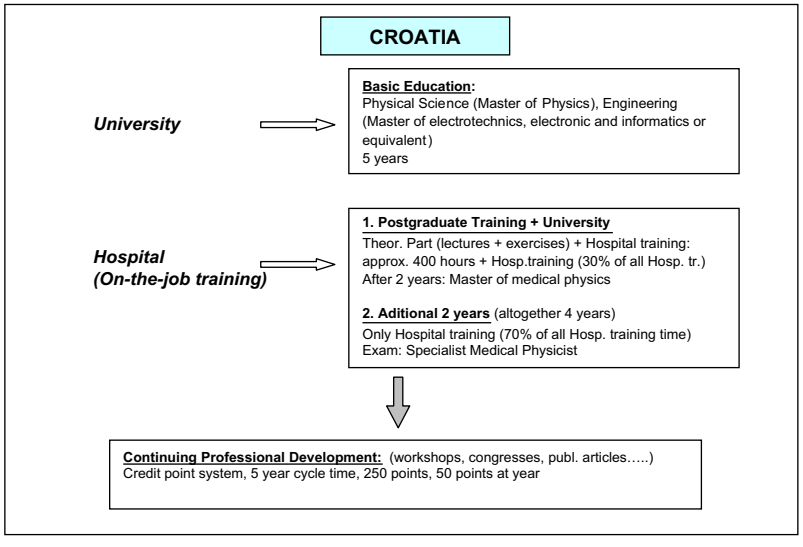
Table 3 (*continued*)

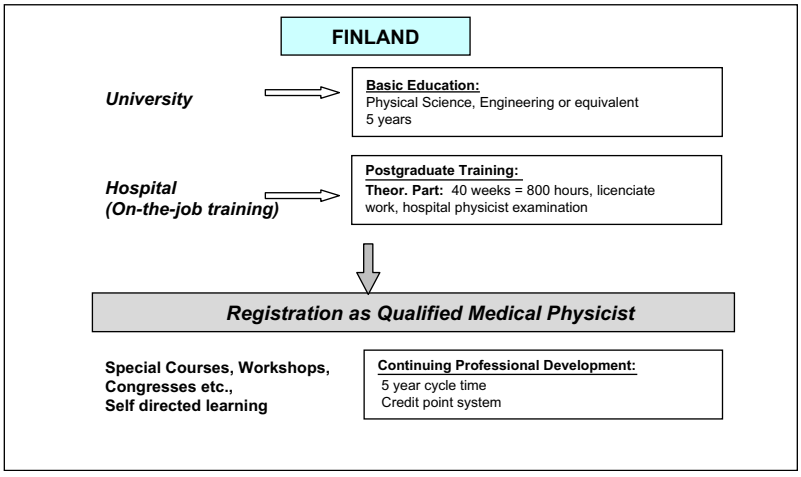
General Information			Continuing Professional Development (CPD)			
Fraction of practising MP?	Proportion: Recognized scheme/not	Two levels: QMP/SMP?	Renewal mechanism?	Based on a CPD system?	Comply with PS N. 10?	CPD Cycle time
100%	20/30	No	Yes (both)	Partially	OeGMP: Yes BMGF: No	6 year
No data	No data		Yes (both)	Yes (both)	Within the guidelines	6 year
		Yes	Not yet			
50%	No data	Not yet	N/A	Yes	Yes	N/A
No data	No data	No	Yes	Yes	Not yet	N/A
100% in RT and NM	27/30	Yes	Yes, but not mandatory	Yes	Yes	
100%	100%	No	Not yet	N/A	N/A	N/A
More than 50%	100%	Yes	Yes	Yes	Fully	5 year
Hospital MP only	80%/20%	No	Yes	Yes	Fully	
70%	60%/40%	No	Yes	Yes	Fully	
60%	90%/10%	No	Yes	Yes	Fully	
50%	100%	No	No	No		
Majority	Nearly all	No	Yes	Yes	N/A	
20—30%	No data	No	N/A	N/A		
				No formal		
N/A	N/A	N/A	No	No		
1: 100% 2: 33%	40%/60%	1: No 2: Yes	1: No 2: Yes	1: No 2: Yes	2: Fully	5 year
100%	10%/90%	No	Yes (the CPD register) Not (the official MP register)	Yes No	In process	
100%	4:1	No	Yes	Will be	Yes	

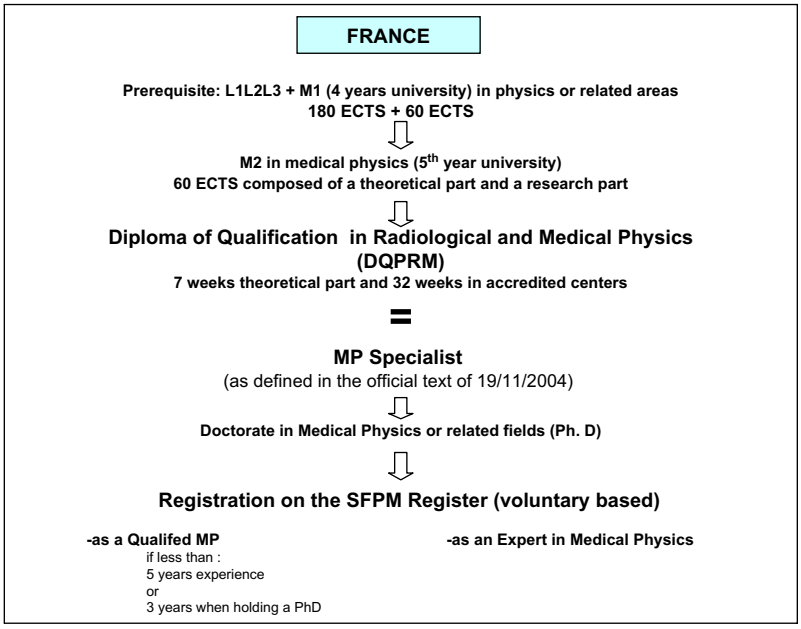
Appendix II: NMO's Education and Training Schemes

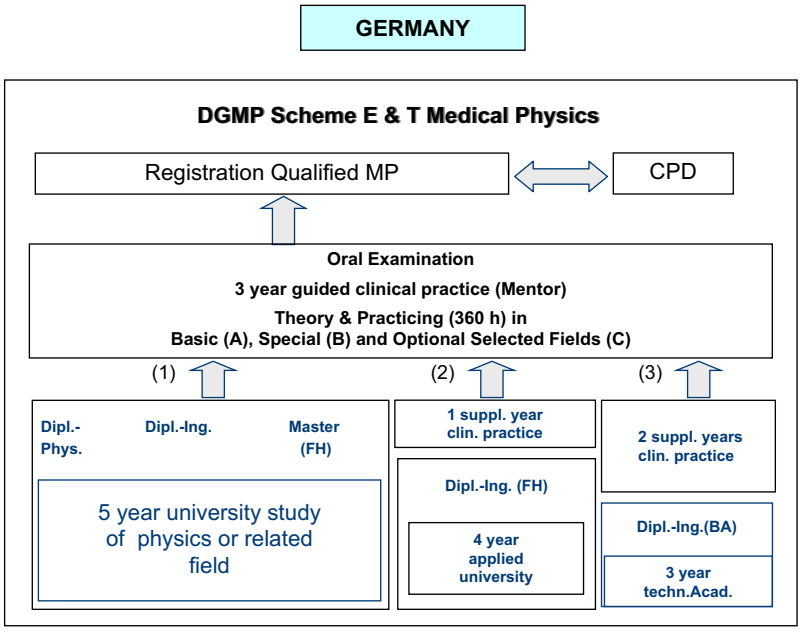


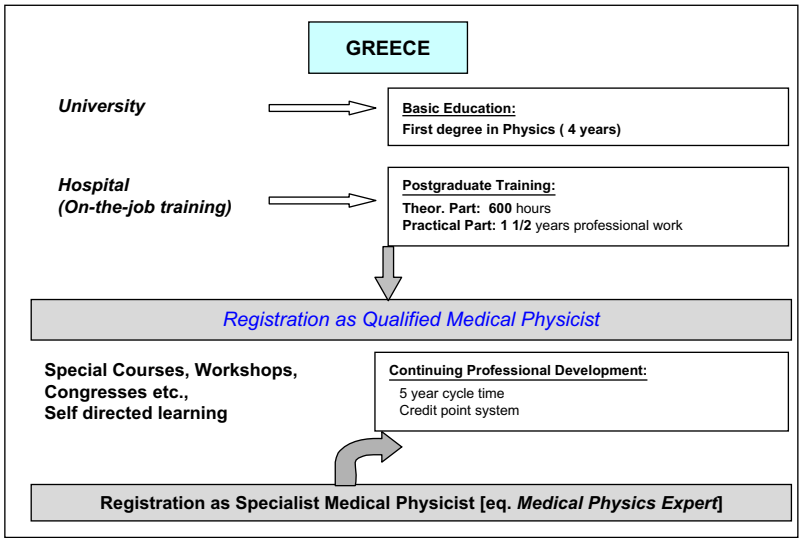


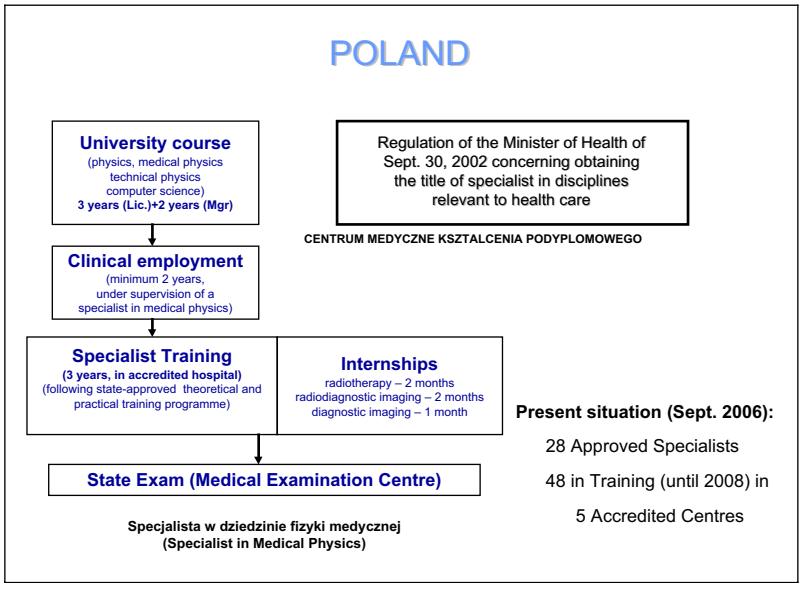


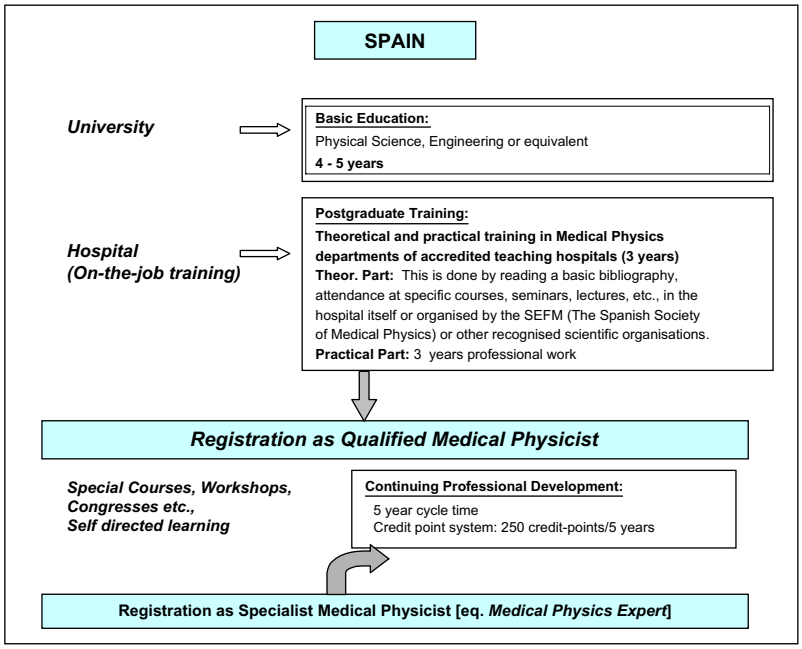

FINLAND
University
Basic Education:
Physical Science, Engineering or equivalent
5 years
Hospital
(On-the-job training)
Postgraduate Training:
Theor. Part: 40 weeks = 800 hours, licenciate work, hospital physicist examination
Registration as Qualified Medical Physicist
Special Courses, Workshops, Congresses etc., Self directed learning
Continuing Professional Development:
5 year cycle time
Credit point system

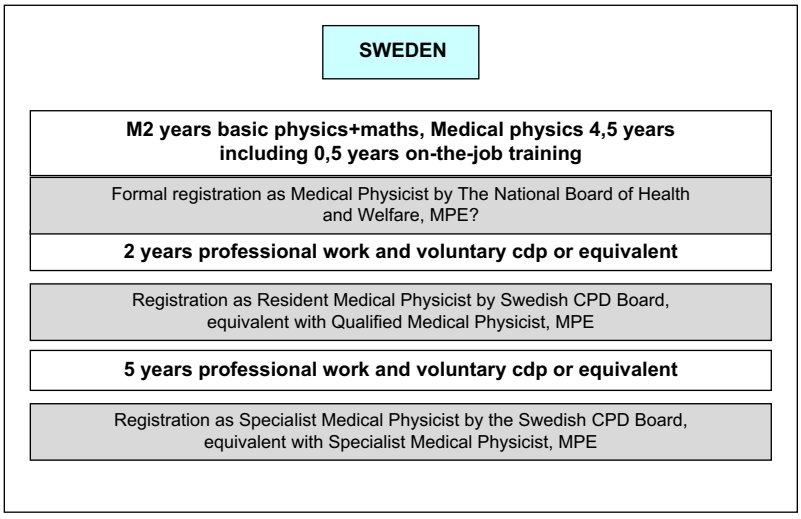

FRANCE
Prerequisite: L1L2L3 + M1 (4 years university) in physics or related areas
180 ECTS + 60 ECTS
M2 in medical physics (5th year university)
60 ECTS composed of a theoretical part and a research part
Diploma of Qualification in Radiological and Medical Physics (DQPRM)
7 weeks theoretical part and 32 weeks in accredited centers
=
MP Specialist
(as defined in the official text of 19/11/2004)
Doctorate in Medical Physics or related fields (Ph. D)
Registration on the SFPM Register (voluntary based)
-as a Qualifed MP
if less than :
5 years experience
or
3 years when holding a PhD
-as an Expert in Medical Physics

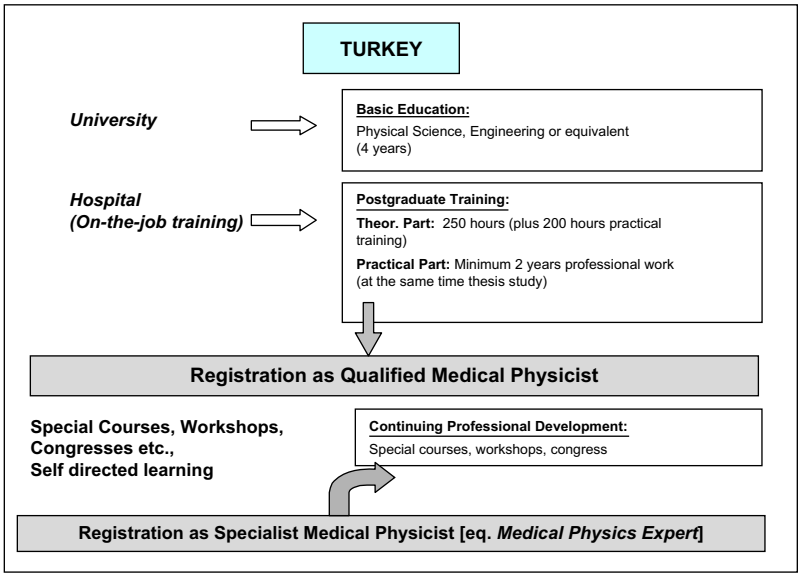

GERMANY
DGMP Scheme E & T Medical Physics
Registration Qualified MP
CPD
Oral Examination
3 year guided clinical practice (Mentor)
Theory & Practicing (360 h) in
Basic (A), Special (B) and Optional Selected Fields (C)
(1)
(2)
(3)
Dipl.-Phys.
Dipl.-Ing.
Master (FH)
5 year university study of physics or related field
1 suppl. year clin. practice
Dipl.-Ing. (FH)
4 year applied university
2 suppl. years clin. practice
Dipl.-Ing.(BA)
3 year techn.Acad.

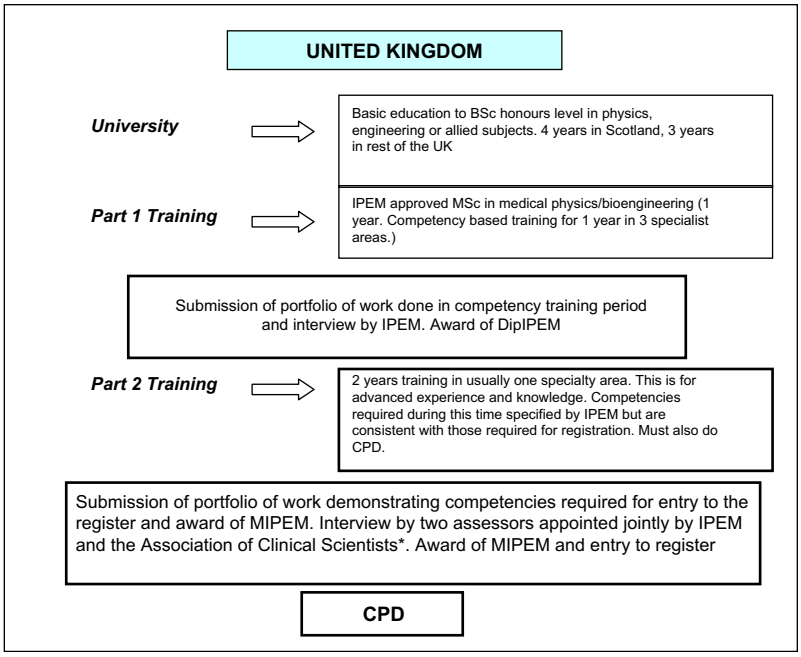

GREECE
University
Basic Education:
First degree in Physics (4 years)
Hospital
(On-the-job training)
Postgraduate Training:
Theor. Part: 600 hours
Practical Part: 1 1/2 years professional work
Registration as Qualified Medical Physicist
Special Courses, Workshops,
Congresses etc.,
Self directed learning
Continuing Professional Development:
5 year cycle time
Credit point system
Registration as Specialist Medical Physicist [eq. Medical Physics Expert]


POLAND
University course
(physics, medical physics
technical physics
computer science)
3 years (Lic.)+2 years (Mgr)
Regulation of the Minister of Health of
Sept. 30, 2002 concerning obtaining
the title of specialist in disciplines
relevant to health care
CENTRUM MEDYCZNE KSZTALCENIA PODYPLOMOWEGO
Clinical employment
(minimum 2 years,
under supervision of a
specialist in medical physics)
Specialist Training
(3 years, in accredited hospital)
(following state-approved theoretical and
practical training programme)
Internships
radiotherapy – 2 months
radiodiagnostic imaging – 2 months
diagnostic imaging – 1 month
State Exam (Medical Examination Centre)
Specjalista w dziedzinie fizyki medycznej
(Specialist in Medical Physics)
Present situation (Sept. 2006):
28 Approved Specialists
48 in Training (until 2008) in
5 Accredited Centres


SPAIN
University
Basic Education:
Physical Science, Engineering or equivalent
4 - 5 years
Hospital
(On-the-job training)
Postgraduate Training:
Theoretical and practical training in Medical Physics
departments of accredited teaching hospitals (3 years)
Theor. Part: This is done by reading a basic bibliography,
attendance at specific courses, seminars, lectures, etc., in the
hospital itself or organised by the SEFM (The Spanish Society
of Medical Physics) or other recognised scientific organisations.
Practical Part: 3 years professional work
Registration as Qualified Medical Physicist
Special Courses, Workshops,
Congresses etc.,
Self directed learning
Continuing Professional Development:
5 year cycle time
Credit point system: 250 credit-points/5 years
Registration as Specialist Medical Physicist [eq. Medical Physics Expert]


SWEDEN
M2 years basic physics+maths, Medical physics 4,5 years including 0,5 years on-the-job training
Formal registration as Medical Physicist by The National Board of Health and Welfare, MPE?
2 years professional work and voluntary cdp or equivalent
Registration as Resident Medical Physicist by Swedish CPD Board, equivalent with Qualified Medical Physicist, MPE
5 years professional work and voluntary cdp or equivalent
Registration as Specialist Medical Physicist by the Swedish CPD Board, equivalent with Specialist Medical Physicist, MPE


TURKEY
University
Basic Education:
Physical Science, Engineering or equivalent (4 years)
Hospital (On-the-job training)
Postgraduate Training:
Theor. Part: 250 hours (plus 200 hours practical training)
Practical Part: Minimum 2 years professional work (at the same time thesis study)
Registration as Qualified Medical Physicist
Special Courses, Workshops, Congresses etc., Self directed learning
Continuing Professional Development:
Special courses, workshops, congress
Registration as Specialist Medical Physicist [eq. Medical Physics Expert]


UNITED KINGDOM
University
Basic education to BSc honours level in physics, engineering or allied subjects. 4 years in Scotland, 3 years in rest of the UK
Part 1 Training
IPEM approved MSc in medical physics/bioengineering (1 year. Competency based training for 1 year in 3 specialist areas.)
Submission of portfolio of work done in competency training period and interview by IPEM. Award of DipIPEM
Part 2 Training
2 years training in usually one specialty area. This is for advanced experience and knowledge. Competencies required during this time specified by IPEM but are consistent with those required for registration. Must also do CPD.
Submission of portfolio of work demonstrating competencies required for entry to the register and award of MIPEM. Interview by two assessors appointed jointly by IPEM and the Association of Clinical Scientists*. Award of MIPEM and entry to register
CPD

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[8] Directive 84/466/Euratom of 3 September 1984 on the basic measures for the radiation protection of persons undergoing medical examination or treatment. Official Journal of the European Communities 5 October 1984:1. No. L 265.

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