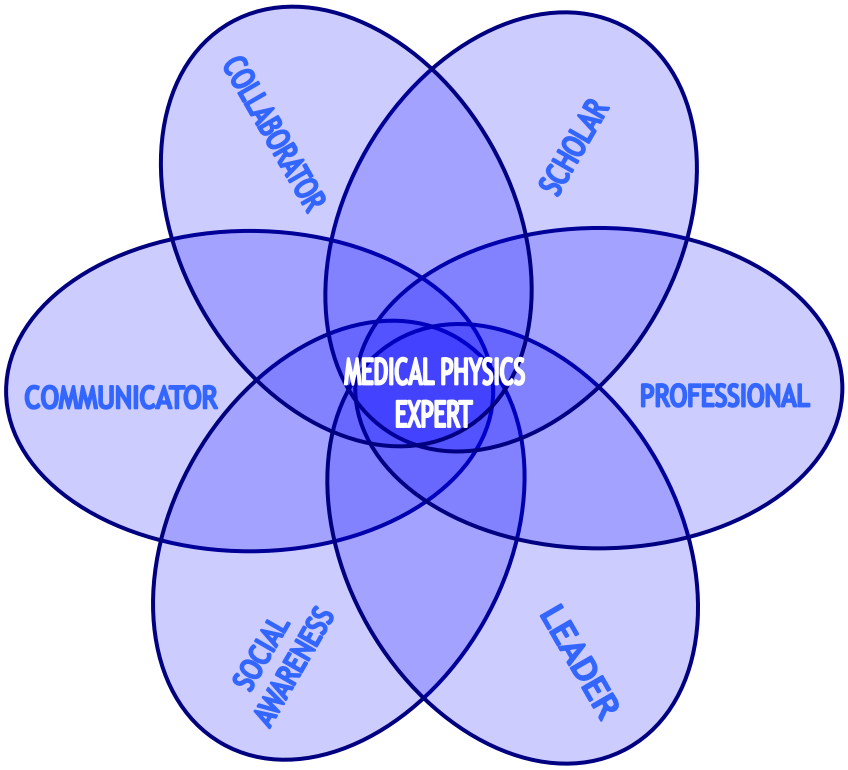
CORE CURRICULUM FOR MEDICAL PHYSICISTS

VOLUME 1



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See also:

Appendix 1 – Literature and Websites
Appendix 2 – Recommended Courses

INTRODUCTION

Medical Physics is a branch of Applied Physics, pursued by medical physicists, that uses physics principles, methods and techniques in practice and research for the prevention, diagnosis and treatment of human diseases with a specific goal of improving human health and well-being [1]. In the Netherlands, the field of expertise of the medical physicist ranges from acquisition of medical equipment to patient diagnosis and treatment [2]. The common goal is to enable a safe and reliable diagnosis and treatment of patients. For this, expert knowledge on technical equipment, interpretation of diagnostic and therapeutic data and understanding of characteristics of the patient's disease is required. For the continuing improvement of treatment and diagnosis, medical physicists play an active role in scientific research and development in various fields. In patient care, the role of the medical physicist in the multi-disciplinary medical team varies from main treatment responsibilities to the responsibility for the safe and correct introduction and use of state of the art medical technology and techniques. The (radiation) safety concerns patients, operators, staff and public.
Medical physicists play a leading role in the strategic planning, commissioning, and safe utilisation of technology and techniques. This also implies the improvement of techniques and the implementation and optimisation of advances of new technologies and techniques.

The purpose of this document is to describe the competences a medical physicist in training needs to achieve in order to operate succesfully as a medical physicist, as well as to describe the necessary minimum required knowledge and skills. This volume 1 represents the general part of the curriculum , mandatory for all medical physicsts in training. Volume 2 represents the particular curricula for each specific field of expertise.

Curriculum describing knowledge, skills and competences
In order to acquire and maintain sufficient knowledge, skills and an appropriate level of competence, both initial and continuing education and training are necessary. This is structured by the Core Curriculum of a medical physicist's education. The Core Curriculum states the knowledge, skills, and competences the medical physicist in training needs to acquire during the four years of training. It is based on the previous curricula of the Stichting OKF, the basic requirements and the European Core Curriculum for radiotherapy by ESTRO. Furthermore, the new curriculum is oriented on the curricula for medical specialists based on the CANMEDS methodology describing the development of competences and also in agreement with the BIG act, which describes knowledge (medical physics expert), academic training (Scholar) and attitude (additional competences). In 2015, the CANMEDs competences were updated, and as a result of that, the competence *manager* has been replaced by the competence *leader.*

Previous guidelines for education and training aimed to provide both theoretical and practical requirements for the specific education and training of medical physics. Those documents focused on knowledge and skills required to act as a specialized medical physicist. They also contained an extensive list of mandatory as well as recommended literature and courses. This current revision has been drawn up using terminology in which learning outcomes are defined in terms of competences. In addition, the amount of mandatory literature and courses is significantly reduced. In the new version, the mandatory and recommended literature and courses are removed from the Curricula texts and are stated in two separate documents. The list of items for each specific topic should be used to identify suitable contents for the theoretical and practical part of the program to become a medical physicist.

Information on the individual plan of education for each medical physicist in training is given in chapter II. Seven general competences, which the medical physicist should master at the end of his/her training, are stated in chapter III. The competence "Medical physicist" is the overall goal of the curriculum and integrates all of the other six competences: Collaborator, Communicator, Social Awareness, Leader, Professional and Scholar. These general competences should be achieved by completing courses, performing clinical, innovation, and research projects and / or (patient) counselling.

In chapter IV the former basic requirements, also defined in the "BIG" act [3] are stated: specific subjects regarding fundamental knowledge, skills and specific competences. These are common topics for all medical physicists, regardless of their field of expertise. The total period for the general part of the training is two years. Chapter V concludes with a guide on how to assess the competences designated in this curriculum.

In volume 2, a number of subjects is defined, which are specific for the field of expertise of the medical physicist and encompass the two remaining years of the program.

For clarity (and to make more frequent updates possible), recommended literature, courses and websites are not provided in the Curicula, but instead in Appendices.

Definition of knowledge, skills and competence [4]

- Knowledge: The outcome of the assimilation of information through learning. or experience; the theoretical, factual or practical understanding of a subject
- Skills: The ability to apply knowledge and use know-how to complete tasks and solve problems.
- Competence: The proven ability (in terms of autonomy and responsibility) to use knowledge, skills and personal, social and/or methodological abilities, in work or study situations and in professional and personal development.

References

[1] International Organization for Medical Physics, www.iomp.org, accessed 10-12-12
[2] Staatsblad Besluit van 25 april 2005: Besluit opleidingseisen en deskundigheidsgebied klinisch fysicus, http://wetten.overheid.nl/BWBR0018235/ accessed 10-12-12
[3] Staatsbesluit 2005 265, art 8.1.3. http://wetten.overheid.nl/BWBR0006251 accessed 10-12-12
[4] http://oxforddictionaries.com/

II. INDIVIDUAL PLAN OF EDUCATION

1. Personal plan of education (4 ECTS)

The curriculum decribes competences, skills and knowledge. These are to be achieved partially by completing courses, but mainly by working in the routine clinic participating in clinical, innovation, and research projects, , and by (patient) counselling. Appropriate projects are not continously available, but depend on various developments in institutes or hospitals.
Therefore, each trainee has to design an individual plan in which she or he arranges participation in upcoming projects at the different hospitals taking part in the education of the trainee in such a way that she or he has been educated and experienced in all topics of the relevant curriculum at the end of the four year traineeship.

2. Time to be spent on each topic*

4 ECTS may be spent on writing the personal plan of eduction, and 6 ECTS may be spent on writing progress reports. The minimum time to be spent on each specific topic of chapter III is 3 ECTS . A total of 90 ECTS (including the personal plan and progress reports) must be spent on the general part of the Curriculum, another 90 ECTS are assigned to the specific field of expertise (Volume 2). 30 (general part) + 30 (specific part, volume 2) ECTS are assigned to the research project. The project does not have to be divided in a general and specific study, but can also be a single project.

Courses can be used to strengthen individual competences. While acquiring the knowledge and skills necessary to work as a medical physicist in a team, the trainee will develop the competences during the full length of the training, working on projects with increasing complexity.

In order for the medical physicist in training to be accountable for the time spent on various projects, for any project the trainee should indicate in his or her progress report:
1) which topics (knowledge, skills and competences) were covered in the project;
2) what aspect of this topic was developed;
3) the time spent on the project.

At the end of the training, the trainee will show in the last progress report that for each topic:
1) the total time spent on projects in which that topic was addressed was at least the required minimum time (quantitatively**).**
2) the topic was adequately covered, and related competences were sufficiently developed (qualitatively**)**.

*60 ECTS = 1 year ; 1 ECTS ~ 28 hours

3. Meetings, Conferences and Internships

Attendance at meetings and conferences

- Attending conferences for continuing education organised by NVKF / KLIFOP / OKF is mandatory.
- Attendance at relevant regional meetings.
- Attendance at at least one international conference.
- Regular participation in work related meetings at the department of medical physics is mandatory.

Internships:

- An internship of at least 30 ECTS in a non-academic setting for the candidate primarily trained in an academic centre, and an internship of at least 30 ECTS in an academic setting for the candidate primarily trained in a non-academic centre
- An internship of at least 4 ECTS at each of the other subspecialities of medical physics.

III. GENERAL COMPETENCES

Medical physics expert

Medical physics expert is the central competence and integrates the other six competences. An excellent knowledge of the specific medical physics field, as well as an excellent knowledge of all basic and state of the art techniques including their (dis)advantages is part of this competence. Furthermore, the medical physicist should have broad knowledge about physiology and pathology and up-to-date diagnostic skills to enable him to collect and interpret relevant data.

Medical physicists have to demonstrate and apply their knowledge in clinical practice through skills and appropriate attitude. Therefore at the end of their training medical physicists should be able to:

- Apply physics and medical standards in their own department;
- Take responsibility for the technical equipment
- Recognize the limits of their expertise;
- examine physics and medical information critically and apply it appropriately to practical decisions;
- follow the current research and development in patient treatment or diagnostics, understand new technologies in clinical practice and implement them in a responsible manner;
- In addition, in case the medical physicist has final responsibility for diagnosis and treatment of patients, he / she is able to diagnose relevant pathology and initiate evidence based treatment. In this case, the medical physicist takes full responsibility for diagnosis and follow-up.

1. Collaborator

Short description:
In order to secure the best possible healthcare for the patients, the medical physicist must be able to work in a mult-disciplinary team that includes: physicians, medical physicists, paramedical staff, computer scientists, assistant medical engineers, administrators. This extends to collaboration with researchers, management of the institute and other healthcare professionals and representatives of the industry. Therefore, the medical physicist must be able to participate in organizing and structuring the clinical process and associated tasks and responsibilities. Moreover, the ability to collaborate constructively also relies on a sound understanding of one's own role within the clinical team and the necessary interactions with individuals and healthcare professional teams.

Competences:

- ability to work and consult effectively within a multidisciplinary team;
- ability to organize and structure team work;
- understanding of the role of the medical physicist within the team;
- understanding of the role of the other professionals;
- ability to work in a regional, national or international team of scientists, healthcare providers and industry;

2. Communicator

Short description:
The medical physicist must be able to communicate in an efficient and unambiguous way, with patients and healthcare professionals, to ensure the safe and accurate provision of healthcare services. This includes the accurate communication of information within the department, with other departments/ staff, colleagues, vendors, other professionals in the industry and the general public. The medical physicist, especially when treating patients, must maintain effective relations with them, discuss the outcomes of diagnostic data and treatment options. In general, medical physicists should be able to give information to the patient (and their carers) or professionals and answer their questions. In these situations it is often necessary to use none—scientific language, whilst ensuring clear and understandable information is given. To prepare the medical physicist for the encounter with patients and their families, it is important to learn basic skills and strategies needed for effective communication.

Competences:

- understanding and correct use of appropriate terminology;
- ability to listen and demonstrate empathy;
- ability to discuss technical and clinical aspects of patient treatment with members of the multidisciplinary team using appropriate terminology;
- ability to discuss general treatment aspects with staff/patients/public who do not have any knowledge of this type of treatment;
- ability to keep medical records effectively and to inform referring doctors adequately
- ability to prepare written material (research and routine) in the form of notes, resumes, reports and scientific papers to be used in clinical practice and to be presented at seminars / conferences or to be appropriate for submission for publication in scientific journals;
- ability to recognize and respond to the emotions of patients and their family and to deal with one's own emotional response to the challenges in working with patients.
- ability to communicate in Dutch, appropriate for all working conditions of a medical physicist (in words and in writing)
- ability to communicate effectively with patients and their relatives

Core curriculum items:

- communication theory
- impact of communication on the patient's wellbeing;
- communication skills in the interaction between patients and healthcare professionals.

3. Social Awareness

Short description:
As a healthcare professional the role of the medical physicist implies social awareness for the consequences that his work or his area of expertise can have for patients, the healthcare organization and society. Also giving education to groups outside of the group of his direct colleagues and, a proactive role in prevention of disease and other negative effects related to medical physics subjects is an essential element of his work .

Competences:

- understanding of, and be able to act within, relevant national legal frameworks, regulations and guidelines;
- ability to act according to best use of resources in the interest of the patient and society;
- ability to take adequate action (within own competency limitations) in response to incidents/accidents;

Core curriculum items:

- show consideration for the ethical, religious, cultural or moral values of other people;
- demonstrate knowledge of ethical considerations in medical practice;
- national and European healthcare legislation;
- national and European regulations on the use of ionizing radiation in medicine;
- national and international guidelines.

4. Leader

Short description:
The medical physicist must be able to supervise an interdisciplinary team. The medical physicist must also be able to coordinate projects both at the level of the department and at institute level. The medical physicist must be able to relate department affairs (personnel, investments and finance) to the organization of the institute and the organization of healthcare in general. Furthermore, in case the medical physicist has final responsibility for diagnosis and treatment of patients, he or she should be able to manage patient flows and waiting lists.

The medical physicist should understand the structure of, and be able to participate in, the management of a department. The trainee should acquire basic knowledge of the organization and management of the local healthcare system and of the relevant guidelines and recommendations from national or international organizations. The trainee should participate in managing tasks during the years of education, on levels of responsibility higher than those of routine services.

Competences:

- ability to manage people
- understanding and awareness of local and national healthcare organizational structures and trends in their development;
- ability to effectively advice the staff and directors concerning new developments in the field of the medical physicist, and to develop, as member of the staff, the strategic policy of the specific department;
- ability to work effectively, in terms of time, equipment and other resources in own work and as part of the multi-disciplinary team;
- understanding of the required technological infrastructure for a department and an awareness of how to establish the necessary interactions with other disciplines;
- ability to organize various aspects of the routine medical physics services.
- ability to effectively manage projects;
- ability to acquire EU Directives, national regulations and guidelines and/or recommendations from national and international organizations;
- understanding of written procedures of a departmental quality management system.

Core curriculum items:

- participate in patient logistics in a multidisciplinary team
- participate in the formulation of a Department's annual review and/or strategic business plan (eg investment plan for medical equipment)
- participate in purchase of new equipment (including formulation of a tender)
- participate in the formulation of criteria for quality control of specified equipment in the department.
- take awareness of investment plans and budget plans
- act as project leader in at least one project concerning
  a) purchase of medical equipment
  b) implementation of medical equipment
  c) introduction of a new or improved treatment or a diagnostic technique.

5. Professional

Short description:
The medical physicist must have a high standard of professionalism and integrity. This includes self-awareness and knowledge of limits as well as high standards of ethical and moral behavior, reliability and responsibility, respect for patient dignity, and autonomy. The medical physicist must be able to act according to medical ethical values established nowadays in order to cope with dilemmas in the clinical environment. The medical physicist knows the relevant laws for health care. Patiënt treatment and diagnosis is evidence based, whenever evidence is available. He organizes safety and risk management, therefore he registers systematically incidents, is capable of performing and organizing safety and risk management and initiates corrective actions.

Competences:

- able to cope with own emotions and with criticism;
- apply appropriate behavior;
- awareness of own limitations of knowledge and competency, thereby knowing when to seek advice;
- take the responsibility for their own actions and know when to take responsibility for physics actions of other members of the physics team, or the multidisciplinary team in the medical process;
- understanding of relevant national professional codes and the need to work within them;
- understand the requirements of data protection and privacy;
- understand organizational policies and national legislation to ensure correct behavior towards colleagues, patients and other members of the public;
- understand the principles of medical ethics and practice medical physics ethically consistent with the obligations of a medical physicist.
- awareness of legal liability and responsibility

Core curriculum items:

- receiving and giving feedback
- discuss an ethical dilemma in the interaction of economical aspects or technological developments and medical ethics

6. Scholar

Short description:
The field of medical physics is a dynamic, quickly evolving discipline. This requires constant development, introduction and implementation of new advanced diagnostic and treatment technologies along with optimisation of existing techniques. Because of their key role in these processes, medical physicists are required to have broad scientific interests and need to constantly learn and acquire new knowledge and also teach others in basic and state of the art knowledge.

The medical physicist often has a central role in the development and advancement of the treatment and in the strengthening of research activities in the international community.
To prepare the medical physicist for this responsibility, a short, focused research project should be undertaken at some stage during the training programme, either as a full-time activity within a well-defined period or on part-time basis over a prolonged time period (e.g. part of the practical training period).
Furthermore, the medical physicist should play a key role in education of candidates medical physics as well as other professionals in his field of expertise.

Competences
- maintain and enhance professional knowledge through ongoing lifelong learning (e.g. develop and maintain a personal continuing-education plan);
- perform a systematic review and interpretation of scientific literature;
- carry out, conduct and supervise scientific research and/or development in medical physics;
- optimise the quality, the practical effect and the scientific value of research;
- build, have and maintain a good national and international network;
- be able to teach and train medical physicist in training
- ability to plan, prepare and perform different phases of a research project;
- ability to acquire first-hand experience in proper scientific evaluation, of both own and published data;
- ability to prepare a scientific manuscript for publication;
- ability to present findings.

Core curriculum items:
- medical physical research performed in the department must lead to at least one publication or a presentation at a scientific conference.
- The candidate must contribute to the education of (candidate) physicists, physicians, assistants, technologists, nurses, laboratory assistants.

IV. FUNDAMENTAL KNOWLEDGE, SKILLS AND COMPETENCES

The following sections provide more detail on the required areas of knowledge, skills and specific competencies for the contemporary medical physicist. For each of the 12 specific topics listed below at least 3 ECTS points must be spent. In total 90 ECTS must be spent on fundamental knowledge skills and competences.

1. Fundamentals of Human Anatomy, Physiology, Psychophysics and Pathology

Short description:
Basic understanding and knowledge of human anatomy is required. It is also a prerequisite for communication and exchange of patient and disease related treatment information. Likewise a basic understanding and knowledge of the human physiology is essential to the understanding of treatment-related adverse effects, and is required for treatment optimisation. As a part of a multidisciplinary team the medical physicist requires a background in basic human anatomy, physiology, psychophysics and pathology.

Knowledge, skills and specific competences:

- sufficient knowledge of human anatomy;
- demonstrate an understanding of relevant human anatomy, physiology, psychophysics and pathology;

Demonstrate an understanding of

- relevant patient exams
- patient counseling
- meetings where patient diagnostics or treatments are discussed by medical specialists

2. *Basics of Physics and Engineering for Medical Devices*

Short description:
A medical physicist must have knowledge of the physics and engineering of medical devices and must be aware of possibilities and pitfalls in their clinical application. Medical physicists must be able to value developments in design and functionality of these medical devices, and to communicate necessary or desired adjustments to vendors/producers.

Knowledge, skills and specific competences:

- basic knowledge of the main physics and engineering principles behind medical devices for therapy, function support and monitoring
    - operating room: minimal invasive surgery, electro surgery
    - ionising and non-ionising radiation: external beams, isotopes, medical lasers
    - Sensory devices
    - Active and passive implants (e.g., pacemakers, cochlear implants, brain implants, passive prosthesis);
    - Acoustics (hearing devices and room-acoustics)
    - Electrophysiological measurements (ECG / EEG / EMG)
    - psychophysical measurements
- basic skills to operate the medical devices
- basic knowledge of patient data management system
- participate in the clinical introduction of a medical device (eg application training)
- write a recommendation for development/adjustment of a medical device that is clinically in use

3. *Quality Assurance of Medical Instrumentation*

Short description:
A medical physicist must be able to organize quality control and quality assurance programs for medical instrumentation and communicate with medical engineers, technicians and application engineers.

Knowledge, skills and specific competences:

- QC and QA for medical instrumentation (hardware and software)
    - acceptance testing
    - maintenance procedures and requirements
    - quality control and assurance
    - end-to-end testing (new techniques, instrumentation, upgrades)
- participate in a maintenance procedure and study the maintenance requirements
- perform and understand the meaning of an acceptance test for new equipment
- design a system for quality management in a department or institute or introduce a program for quality assurance for (a set of) medical devices or procedures

4. Principles of Medical Imaging and Image Handling

Short description:
The medical physicist is acquainted with common imaging techniques for diagnostics, functional imaging and 3D molecular-imaging modalities (e.g. radiography & fluoroscopy, CT, conventional and CT simulators, PET, SPECT, PET/CT, US, MRI, MRI spectroscopy and fMRI): the physics envolved, advantages and limitations (applications), the sources of image errors, the uncertainties and the resolution limits. The physicist can understand acquisition and interpretation of the images from the various modalities. Within the multi-disciplinary team it is the role of the medical physicist to ensure that imaging equipment in the treatment process is used appropriately, effectively and safely.

Knowledge, skills and specific competences:

- knowledge of anatomical and functional imaging using different modalities and techniques;
- understanding of the physics and principles of imaging in treatment processes, the sources of image errors, the uncertainties and the resolution limits;
- understanding of the different acquisition protocols in different imaging modalities and the effect of the adjustable parameters to the appearance and the properties of the image;
- appreciate the effect of contrast media in different modalities and the limits of the imaging signal for appropriate application;
- Knowledge of definition and measurements of image quality and sources of image distortion;
- Knowledge of noise and resolution;
- Knowledge of effect and management of patient organ motionin imaging;
- understanding of functional imaging techniques;
- Knowledge of image handling, digital image processing, reconstruction algorithms;
- knowledge of Dicom standards
- perform (for all subspecialities exept Audiology) and understand the meaning of an acceptance test or commissioning of a medical imaging modality;
- design and maintain a quality control program for a medical imaging modality;
- write the appendix of requirements and options of an invitation to tender;

5. *General Safety Principles and Risk Management in the Medical Environment*

Short description:
A medical physicist has to assess the impact of many radiological, electrical, chemical, mechanical and biological hazards to patients and hospital staff; therefore, potential hazards and necessary precautions have to be understood. A sufficient appreciation of best practice concerning safety and risk management must be gained to be able to contribute to, facilitate, implement and improve safety management systems.

Knowledge, skills and specific competences:

Knowledge of

- principles of safety and risk management;
- electrical, electro-magnetic, magnetic and mechanical safety;
- principles of radiation protection, ionising radiation and non-ionising radiation (microwave, RF and magnetic fields, ultraviolet, lasers, ultrasound);
- the implementation of the VMS (”Veiligheid Management System”)
- the “Convenant Veilige Toepassing van Medische Technologie in de medisch specialistische zorg” in your institution.

Project

- (re)analyze a recent incident in your department using the department’s method (e.g. PRISMA);
- Perform a prospective risk analysis.

Competenties resp abilities:

- ability to identify and minimize risks in order to avoid preventable incidents;
- ability to plan an investigation following an incident to analyze its causes and consequences and design changes to practice to avoid repetition;
- ability to measure and improve effective safety performance;
- ability to define emergency plans and manage emergency situations;
- ability to assess, manage and control human factors and safety-related behaviour;
- ability to assess national regulations;
- ability to perform a prospective risk analysis for existing or new equipment or treatment technique, implementing the necessary of the below stated aspects and identifying quality control checks for associated equipment;
- ability to discuss and manage safety;

6. *Principles of Quality Management*

Short description:
Quality management requires an organisational structure (quality system) wherein responsibilities, procedures, processes and resources are clearly defined. It should be supported by the department management in order to work effectively and should be as comprehensive as is required to meet the overall quality objectives. It must have a clear definition of its scope and of all the quality standards to be met and requires collaboration between all members of the medical team. The quality system must incorporate compliance with all the requirements of national legislation, accreditation, etc. and requires the development of a formal quality assurance program that details the quality assurance policies and procedures, quality control tests, frequencies, tolerances, action criteria, required records and personnel.

The complexity of clinical processes generally continue to increase which requires a high level of safety and constant quality improvement. The quality management of processes should be continuously improved and modified to meet these evolving needs and demands. As part of the multi-disciplinary team medical physicists are mandatory to contribute to the implementation and maintenance of the departmental safety and quality management system to achieve the following objectives:

- assure the safety of the patient undergoing diagnostic and therapeutic procedures related to medical physics;
- assure the safety, quality and efficiency of the medical physics services;
- increase its cost effectiveness;
- introduce the concept of improvement and upgrading of the medical physics services.

The Quality Assurance process involves all steps of the treatment.

Knowledge, skills and specific competences:

- knowledge of quality management systems, records, audit and improvement of quality;
- knowledge of relevant quality standards;
- ability to participate in quality management;
- ability to identify and formulate improvements to upgrade quality systems;
- ability to define quality objectives;
- ability to define control tests, frequencies, tolerances, action criteria, records and personnel;
- ability to measure effective quality performance;
- ability to improve effective quality performance;
- ability to assess the national legislation, accreditation requirements;
- knowledge of national and international recommendations and local protocols for quality assurance.

Project

- participation in quality audit, analysis and improvements.

7. Radiation Protection for Ionising Radiation

Short description

The acceptance by society of the risks associated with radiation is conditional on the benefits to be gained from its use. The application of radiation safety standards realizes the restriction of and the protection against those risks.

Medical physicists must have a broad knowledge of radiation protection. They have to address the needs of protecting the patient, personnel and the general public in the department. They have to know the physical and biological effects of radiation for exposed individuals, the relevant regulations, methods of compliance and record keeping. This knowledge will allow them to assess the radiation risk and optimise the medical exposures. They will be asked to apply the ALARA and dose limitation principles in the design of radiation therapy facilities, treatment and imaging protocols. The physicist is also able to apply all legal regulations (e.g., licences for the department).

Knowledge, skills and specific competences:

- understanding of the principles of radiation safety procedures;
- ability to measure and improve effective performance of radiation safety procedures;
- ability to investigate and assess risk factors of radiation;
- ability to optimise medical exposures;
- ability to verify that the medical physics program is in compliance with applicable national radiation safety regulations (e.g., radioactive materials licenses, occupational dose limits, and review of radiation surveys for any new construction);
- ability to perform radiation surveys of an area using appropriate dose-rate meters
- ability to perform design calculations for the different rooms;
- ability to discuss the use of personal dosimeters;
- ability to prepare the documentation needed for audits by the radiation protection authorities;
- Ability to discuss the principles of radiation safety;

Projects:

- perform radiation survey of an area using appropriate dose-rate equipment;
- study or perform practical design calculations for a room in which ionizing radiation will be applied, such as a linac room, (PET)-CT room, simulator room, the local radionuclide preparation laboratory or brachytherapy source room;
- plan and practice contingency measures, e.g. regarding lost source, spill;
- discuss decontamination procedures after a spill of liquid radionuclide;
- evaluate the application of current laws, regulations and recommendations as applied locally
- join the local Radiation Protection Commission of your department or institute;
- join the local medical ethics committee as advisor regarding the use of ionizing radiation in human research.

8. Health Technology Assessment (including Medical Statistics)

Short description:

An important technique in biomedical research is the ability to understand the properties, or knowledge, of a whole population from those of a smaller random sample of that population. Such research might be aimed at best practice (evidence based medicine) and methodology requires a.o. the understanding and application of statistical methods. Medical physicists are frequently involved in such studies, specifically they may be responsible for designing, analysing and interpreting the experiments and processing the resultant data. Moreover, they should be able to correctly and critically analyse published research results. Therefore, medical physicists have to be trained in the fundamentals of methodolgy and statistics of biomedical research.

Knowledge, skills and specific competences:

- knowledge about cost-effectiveness studies;
- ability to perform a structured review of the literature
- ability to understand the fundamentals of biostatistics;
- ability to design studies in clinical and biomedical research;
- abilty to perform the most common statistical tests;
- ability to apply computational techniques and dedicated software packages for statistical data analysis;
- ability to analyse and interprete experimental results;
- knowledge of the possibilities of medical big data studies
- knowledge of and ability to perform or analyse outcome measurement studies (such as survival curves for e.g, oncology patients, complication rates, and PROMs - Patient Reported Outcome Measures – and PREMs - Patient Reported Experience Measures)
-

Project:

- participate in the setup of studies aimed at evidence based practise

9. Information and Communication Technology

Short description:
There is a clear need for the modern medical physicist to have a good understanding of Information and Communication Technology (ICT). In many departments in the hospital, a number of computer systems which are used to design, manage and deliver highly complex treatments are present. The medical physicist is required to work and communicate effectively with IT professionals from inside and outside the hospital organisation. Consequently, the medical physicist must have knowledge of the main systems for information sharing, storage, and retrieval in a hospital, and of the formats most common for medical data, such as DICOM.

Knowledge, skills and specific competences:
- DICOM – general understanding of DICOM and its operation;
- PACS – general understanding of PACS and its operation.
- IHE - general understanding of IHE and its operation
- the operational relationships between hospital information systems and management systems used;
- ability to understand and discuss ICT concepts and data connectivity standards, with other healthcare professionals,
- relevant data and ICT security standards for collection, storage and transmission and data protection legislation;
- licensing principles;
- Data safety (integrity and privacy, protected sub-nets, etc)
- Knowledge about the role and responsibilities of the Chief Information Officier in the institute

10. Basics of Healthcare Finance, Law and Ethics

Short description:
The basic principles of healthcare finance, laws and medical ethics are an important framework for acting in a clinical setting. Basic knowledge has to be acquired on the Dutch healthcare system, healthcare regulations and ethical considerations in healthcare and medical research. The medical physicist must be able to negotiate about financial matters with the hospital directors, and health care insurance companies.

Knowledge, skills and specific competences:
- Knowledge on the structure of the Dutch healthcare system
- Government procurement in the European union.
- Privacy legislation
- Ethical considerations in medical research
- Relevant legislation regarding the required time medical information must be stored
- Intellectual property

11. Interaction with Health professionals, Patients and their Proxies

Short description:
In order to ensure effective healthcare, it is important for medical physicists to effectively communicate with other health professionals. Also understanding of the behavior of patients is important. What can we do to obtain agreement of treatment between the health professionals, and what can we do to convince patients to cooperate with respect to therapy and invasive diagnostics? In addition, the medical physicist should get a relevant psychological background on how to deal with emotions.

Knowledge, skills and specific competences:

- interactions with GPs and other health professionals
- psychological principles in the practice of medicine
- behavior of sick people and carers
- principles of counseling
- bad news consultation

V. ASSESSMENT METHODS TO EVALUATE KNOWLEDGE, SKILLS AND COMPETENCES

PROGRESS REPORTS (6 ECTs)

The progress in the trainee's knowledge, skills and competences is monitored and assessed twice a year by a progress report (voortgangsverslag), which is sent for evaluation to the "College van Toetsing". In this written report, the trainee describes all performed activities such as theoretical studies, courses, projects, acquired knowledge and skills. The trainee also reflects on the competences that were worked on during the various projects, what went well, and what could be improved, and in what way the candidate is going to reach improvement. The reports can be seen as a logbook or portfolio.

The trainee also has a progress meeting (voortgangsgesprek) twice a year, a.o. based on the progress report with the trainer (opleider) and co-trainer (co-opleider).

Two additional methods for assessment of progress are suggested. These methods are mainly intended to give feedback to the trainee for improvement of the necessary competences.

1. **MULTI-SOURCE FEEDBACK (MSF)**
   Multi-source feedback (MSF) is sometimes termed 360-degree assessment. With MSF specific instruments can be used designed to gather feedback about particular competences and skills of the trainee. Feedback can be provided by completing a questionnaire-based tool.
   MSF usually includes feedback solicited from two or more sources/observers. Observers may include all healthcare professionals that are involved in the candidates projects, like physicians , nurses, technologists, and medical physisist (trainees)).
   MSF can supplement traditional sources of assessment (e.g., examinations and preceptor observations) by providing input from people who do not normally have a hierarchal responsibility for providing feedback, yet may have a different perspective on actual trainee's performance. Finally, MSF encourages reflection and promotes development of a self-improvement plan.

2. ENCOUNTER CARDS OR KPB

Encounter cards (in Dutch: Korte Praktijk/Klinische/Deel Beoordeling (KPB, KKB or KDB) are a type of in-training tool characterised by direct observations that are documented after brief encounters between an observer or supervisor and the trainee in a (clinical) setting. The encounter card is a method of direct assessment based on a short questionniaire.

Different forms are used:

- ✓ To evaluate a project
- ✓ To evaluate a presentation

Examples can be found here: http://www.nvkf.nl/archief-van-documenten-voor-klinisch-fysici-io

More methods can be found on the CANMEDS website:
http://rcpsc.medical.org/canmeds/resources/handbook_e.php)