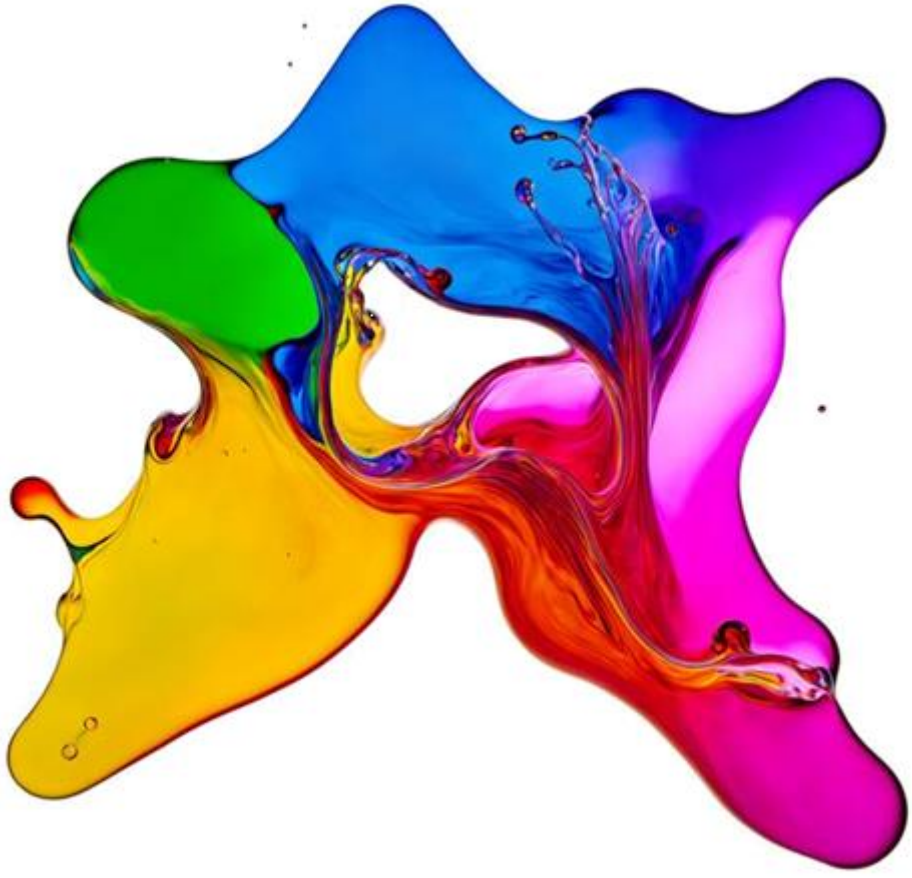
Integral Curriculum for the
MEDICAL PHYSICS EXPERT
2024



College Consilium
Stichting Opleiding Klinisch Fysicus
www.stichtingokf.nl

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I. Introduction

I.1. The Medical Physics Expert

The Medical Physics Expert (MPE) applies physics principles in the medical setting [1, 2, 3, 4, 5]. In the Netherlands the expertise and official requirements for training of the MPE are defined by law [6, 7].
The MPE has three main responsibilities:

1. Quality Assurance: clinical introduction, development, quality assurance of medical technology for diagnosis and treatment, and continuous development of a quality management system. The MPE is also qualified to advise on and act in radiation protection matters and/or other subjects within the domain of physics.
2. Diagnosis and treatment: the MPE advises on, and is responsible for aspects of, the diagnosis and treatment of individual patients. The MPE is responsible for effective and correct use of medical devices and the correct dose delivery for diagnostics and treatment, both for the individual patient as well as the entire patient group.
3. Innovation: initiating innovations to improve diagnostics and treatments as well as performing scientific research and translating the results into new methods for diagnosis and treatment. The MPE also determines and develops, together with medical doctors and the management, the strategic and medical-physics policy of the institute and/or department.

The field of expertise of the MPE ranges from acquisition, development, innovation, clinical implementation, and quality management of medical technology, to ensuring and optimizing the quality of diagnosis and treatment of individual patients [6, 8, 9]. The common goal is to enable and ensure the optimal, safe, and reliable diagnosis and treatment of patients. For this, expert knowledge on fundamental physics, technical equipment and information technology possibilities, interpretation of diagnostic and therapeutic data, and understanding of characteristics of the patient's disease is required. MPEs play an active role in scientific research and innovation in medical technology aimed at continual improvement of treatment and diagnosis. In patient care, the role of the MPE in the multi-disciplinary medical team varies from primary treatment responsibilities to the responsibility for the safe and correct introduction and use of state-of-the-art medical technology and techniques. The MPE is often responsible for ensuring the radiation safety of patients. In some cases, the MPE has the role of the Radiation Protection Expert (Dutch: Coördinerend Deskundige) and is also responsible for ensuring the radiation safety of the staff and the general public.
The MPE plays a leading role in the strategic planning, commissioning, and safe use of technology and techniques, and therefore is also actively involved in the continual improvement of diagnostic and treatment techniques and technological advancements.

In technology-driven medicine, the MPE works in close collaboration with the physician and other technical healthcare professionals such as engineers and technicians. The MPE is the specialist trained in applying fundamental and applied physics, mathematics, and technology in the clinic at an academic level. in some cases, the MPE is responsible for applying medical physics knowledge and skills for the benefit of the individual patient.

There are four differentiations of MPE in the Netherlands: General Medical Physics (AKF), Audiology (AUD), Radiology and Nuclear Medicine (RNG) and Radiotherapy (RTH). In a four-year post-master's residency, candidates are trained in one of these differentiations.

A master's degree in physics or equivalent is a prerequisite to enter the four-year post-master's residency program to become an MPE. Only equivalent master's programs in the Netherlands approved by Stichting OKF are accepted (https://www.stichtingokf.nl/belangrijke-documenten/geaccepteerde-vooropleidingen/). [6, article 6]

I.2. Curriculum

The purpose of this document is to describe the Knowledge, Skills, and Competences (KSC) that a MPE needs to achieve during their residency. The KSC are structured in Chapter II in seven fields of expertise (Dutch: Kennisgebieden):

1. The patient: Fundamentals of Human Anatomy, Physiology, Psychophysics, Pathology, and Interacting with Patient
2. Physics and Engineering in Medicine
3. Risk Management, Quality Control and Safety in the Medical Environment
4. Radiation Physics, (Radiation) Protection and Dosimetry
5. IT and data science
6. Organisation, management, finance, laws, and ethics in healthcare
7. Science and Innovation

Additionally, this document describes the CanMEDS-roles that the resident must develop. The CanMEDS-roles are described in Chapter III.

The resident is requested to implement the curriculum in an individual training plan covering the four-year training period. During this training period the resident reports on progress via several progress reports. To monitor the progress of the MPE resident this curriculum describes several tools: Deliverables, EPAs and an ECTS table. Additionally, the MPE should request feedback in a formal and informal setting.

Part of the knowledge, skills and competences are acquired in a structured way organized by the cluster, e.g., by internships, education, and clinical rotations. The local specific implementation of the curriculum should be detailed in the cluster curriculum (Dutch: Clusterleerplan).

This curriculum is based on the previous curricula of the Stichting OKF and on the curriculum for medical specialists. Furthermore, the curriculum complies with the Dutch Healthcare Professionals Act (Dutch: Wet op de beroepen in de individuele gezondheidszorg – wet BIG).

I.2.a. Knowledge, Skills and Competences & CanMEDS-roles

To acquire and maintain sufficient knowledge, skills, and an appropriate level of competence, both initial and continuing education and training are necessary.
Chapter II describes the knowledge, skills, and competences that the MPE in training needs to acquire during the four years of training. For each of the fields of expertise, the knowledge, skills, and competences can be defined either for separate differentiations or for a "common trunk" in case they are relevant for all differentiations.

The knowledge, skills, and competences are defined as follows:

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

Chapter III describes the CanMEDS methodology [10] that describes the development of fundamental roles the MPE can have, similar to the curriculum of medical specialists. For this curriculum, the following CanMEDS-roles are defined: Medical Physics Expert, Collaborator, Communicator, Health Advocate, Leader, Professional and Scholar.

I.2.b. Deliverables, EPAs and ECTS

In this curriculum, three tools are used to plan and monitor the progress of the resident in a structured way. These are deliverables, EPAs and ECTS. They are defined as follows:

Deliverable: Proof of completing a certain activity, demonstrating the resident's knowledge, or skills or competence. The deliverables are presented in Chapter II for each of the 7 fields of expertise (Dutch: Kennisgebieden). A comprehensive list of deliverables is attached in Appendix V.1. The exact wording of each deliverable is not set in stone and should be seen as strong suggestions. Residents should report deviations and progress of their deliverables in their individual training plan and progress reports.

EPA: An Entrustable Professional Activity (EPA) is a unit of professional practice that can be fully entrusted to a resident, once the resident has demonstrated the necessary competence to execute this activity unsupervised [11]. EPAs are used in monitoring progress for the field of expertise "The Patient" for the Audiology differentiation and are attached in Appendix V.2.

ECTS: European Credit Transfer and Accumulation System.
In this curriculum ECTS are used. In this system, 60 ECTS equals 1 year, 5 ECTS equal 1 month, 1 ECTS equals 28 hours.

The estimated number of ECTS to be spent per topic is listed in Table 1. These numbers are based on experience and estimate the required time for a typical resident to acquire the minimum amount of knowledge, skills, and competences per topic. As residents have varying backgrounds, it is possible that the estimated amount of time to be spent on the topic for the individual resident is higher or lower than indicated in Table 1. Deviations from the estimated number of ECTS due to individual circumstances should be discussed with the supervisors and indicated in the individual training plan.

For differentiations RNG and RTH, the field of expertise "Physics and Engineering in Medicine" is broken down in more detailed topics, as can be seen in Table 1. The estimated number of ECTS can be fulfilled in different activities, e.g., self-study, following courses or attending conferences, or more actively, e.g., patient counselling, participating in clinical innovation projects or joining committees (NVKF, NCS). Residents can plan additional activities to develop CanMEDS-roles, e.g., (peer-to-peer) coaching or a course in communication skills. Activities and estimated ECTS should be detailed in the personal training plan (Dutch: Opleidingsplan), see Chapter I, Section I.3.a.

Time is reserved for writing the individual training plan (4 ECTS) and progress reports (6 ECTS) (see Table 2). To be more flexible in taking advantage of interesting opportunities that emerge in clinical practice, it is recommended to allocate an appropriate number of ECTS (e.g., 3 ECTS per block of 30 ECTS) to unforeseen activities (see Table 2).

Residents employed by academic institutions are expected to spend a certain amount of time (30 ECTS or more) at an internship in a non-academic institution, and, conversely, residents employed by non-academic institutions should spend 30 ECTS or more in an academic institution

(See Table 3). Internships at the 3 other medical physics differentiations (4 ECTS each or more) should be performed to get acquainted with the complete spectrum of medical physics (See Table 3). Time spent during these internships are to be distributed over the seven fields of expertise. Furthermore, ECTS in the training plan should be attributed to participation in regular work-related (team/department) meetings or national meetings and conferences related to medical physics. Additionally, active participation in a national or international committee, on behalf of the NVKF or Stitching OKF is strongly encouraged.
Note that the total estimated number of ECTS allocated in Table 1 is significantly lower than the total number of ECTS for the residency (240 ECTS); the difference in ECTS can be used as desired, on areas of expertise in each of the differentiations, as a means to personalize the individual training plan.

Table 1: The number of ECTS estimated to acquire the minimum amount of knowledge, skills, and competences per topic, shown for each of the 4 differentiations.

	AKF	**AUD**	**RNG**	**RT**
K1: The patient: Fundamentals of Human Anatomy, Physiology, Psychophysics, Pathology, and Interacting with Patient	6	63	5	6
K2: Physics and Engineering in Medicine	36	25	31	32
K2.RNG.1: CT			4	
K2.RNG.2: MRI			5	
K2.RNG.3: PET			4	
K2.RNG.4: SPECT			3	
K2.RNG.5: Isotopes, tracers, and the radionuclide laboratory			2	
K2.RNG.6: Radiography, mammography, fluoroscopy and DEXA			4	
K2.RNG.7: Ultrasound			2	
K2.RNG.8: Quantitative image analysis and diagnostic monitors			3	
K2.RNG.9: Therapy			3	
K2.RTH.1: Treatment equipment for external radiotherapy				6
K2.RTH.2: Treatment simulation and planning				8
K2.RTH.3: External beam treatment delivery, verification and modification				7
K2.RTH.4: Brachytherapy				5
K3: Risk Management, Quality Control and Safety in the Medical Environment	18	16	18	16
K4: Radiation Physics, (Radiation) Protection and Dosimetry	17	3	20	22
K5: ICT and Data Science	11	9	11	9
K6: Organisation, Management, Finance, Laws and Ethics in Healthcare	5	10	6	5
K7: Science and Innovation	60	60	60	60
Total	**153**	**186**	**151**	**150**

Table 2: The number of ECTS estimated to be spent on additional areas.

	All
Individual Training Plan	4
Progress reports	6
Unforeseen (per block)	3

Table 3: The minimum number of ECTS to be spent on internships, these are to be distributed over the seven fields of expertise shown in Table 1.

	All
An internship in an academic or non-academic setting	30
An internship at each of the 3 other differentiations of medical physics	12

I.2.c. Feedback

Feedback is a crucial tool during the residency. The MPE is expected to request regular feedback from their supervisor, colleagues and peers, interdisciplinary teams, and patients. Conversely, the (team of) supervisors are expected to provide ample (unsolicited) feedback to the resident. There are several methods for requesting feedback, the resident is encouraged to use the following methods:

- **Self-assessment and reflection**: The resident is expected to reflect on their progress using self-assessment and reflection.
- **Informal feedback**: Feedback is often given in an informal setting. Residents are encouraged to gather informal feedback often and from a variety of people.
- **Multisource feedback** (MSF or 360-degree assessment): A questionnaire is sent to multiple colleagues (observers) to gather feedback about particular competences and skills of the resident. Observers can include all professionals that are involved in the resident's projects or activities, such as physicians, nurses, technologists, and medical physicists. MSF encourages reflection and promotes development of a self-improvement plan.
- **Encounter cards** (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 resident in a (clinical) setting. The encounter card is a method of direct assessment based on a short questionnaire.

In the personal training plan, residents should detail how feedback is obtained during the residency.
Clusters should facilitate feedback, describe procedures in the Cluster Curriculum (Dutch: Clusterleerplan) and provide formats for MSF and encounter cards. Additional format documents and methods may be found online at:

- https://nvkf.nl/nl/documenten?field_categorie_tid=24
- www.royalcollege.ca/rcsite/documents/canmeds/assessment-tools-handbook-e.pdf

I.3. Individual implementation

I.3.a. Training plan

Each resident has to design an individual training plan (Dutch: Opleidingsplan) in which the resident describes the activities planned to acquire the knowledge, skills and competences described in this curriculum. Additionally, residents should describe how they plan to develop in the CanMEDS-roles.
In the training plan, residents should plan activities in blocks of 30 ECTS. Within each block the resident can plan courses, projects, internships and common activities. The training plan should motivate the residents' choices on how the estimated number of ECTS are fit in the training plan. It is advised to plan in larger thematic blocks rather than planning in too much detail. During the residency, changes or amendments to the initial training plan are to be expected, these are described in the progress reports. The training plan is written in collaboration with the residents'

supervisors and is assessed and approved by the College of Examination (Dutch: College van Toetsing) of the Stichting OKF.
A template of an individual plan can be found online:
https://www.stichtingokf.nl/belangrijke-documenten/formats-opleidingsdocumenten/.

I.3.b. Progress reports

The progress in development of knowledge, skills and competences is reported via a progress report (Dutch: Voortgangsverslag). The resident also reflects on the development of CanMEDS-roles during activities and describes what should be developed additionally before the end of the residency.
Changes with respect to the individual training plan should be indicated. If these changes have consequences for the planning of subsequent blocks, a plan should be made describing how knowledge, skills and competences are acquired in subsequent blocks.
This report is primarily meant as a portfolio for the resident and is monitored and assessed by the supervisor. The report should be provided eight times during the residency, once per block of 30 ECTS. The approval of the supervisor per block is required for the final exam. The report is sent for evaluation to the College of Examination (Dutch: College van Toetsing).

A template for the progress report can be found here:
https://www.stichtingokf.nl/belangrijke-documenten/formats-opleidingsdocumenten/.

The exam regulations can be found here:
https://www.stichtingokf.nl/belangrijke-documenten/reglementen/

II. Fundamental Knowledge, Skills and Competences

The following sections provide more detail on the required areas of knowledge, skills and specific competences for the MPE.

II.1. The patient: Fundamentals of Human Anatomy, Physiology, Psychophysics, Pathology, and Interacting with Patient

II.1.a. Common Trunk

Short description

The MPE is part of a multidisciplinary team and has a basic knowledge of human anatomy, physiology, psychophysics and pathology; where psychophysics is the scientific study of the relation between stimulus and sensation. The MPE understands diagnostic and treatment-related effects. The MPE communicates effectively with other health professionals and the patient to ensure effective healthcare.

Knowledge, skills and competences

The MPE has knowledge of:

- Relevant human anatomy, physiology, psychophysics and pathology,
- Radiobiology, i.e., the effects of different forms of radiation on cells,
- Basic psychological principles in the practice of medicine,
- The principles of counselling, and
- Fundamentals of patient diagnosis and treatment, and rehabilitation.

The MPE is able to:

- Interact with patients and carers,
- Recognise basic anatomy, physiology and pathology of the major parts and organs of the human body in images created on all radiology or nuclear imaging modalities, and
- Balance the technical quality of treatments as well as the quality of life of the patient, medical considerations and treatment costs.

II.1.b. General Medical Physics

Short description

Advanced knowledge of anatomy, physiology and pathology, beyond the basic curricular requirements, is needed to effectively communicate and operate within a multidisciplinary team involving multiple departments within the hospital or institution.

Knowledge, skills and competences

The MPE has knowledge of:

- The anatomy, physiology and pathology of for instance the cardiovascular system heart and vascular system, lungs, brain, gastrointestinal tract, and the visual system,
- Methods and techniques to assess the function or dysfunction of the organ systems,
- The development of cancer, the nature of the various forms of cancers, and the associated diagnosis and treatment options, including multi-modality options, such as chemotherapy or chemoradiation, surgery, immunotherapy and hormone therapy, as well as High-Intensity Focused Ultrasound (HIFU), Photo-Dynamic Therapy (PDT), Radio Frequency Ablation (RFA), hyperthermia, radiotherapy and nuclear therapy, and

- The process of how medical doctors of different specialties come to a diagnosis of a particular pathology.

The MPE is able to:

- Understand the questions and challenges facing medical staff and translate those questions in medical physical terms.

The MPE is competent to:

- Participate/accompany/observe a medical doctor while they do their diagnosis and image analysis, for all major anatomic parts and clinical topics, and
- Identify all major organs in images acquired via medical imaging modalities.

II.1.c. Audiology

Short description

In the Dutch healthcare system, the Audiology MPE is ultimately responsible for the audiological care given to patients. As such, the MPE must have a thorough understanding of the anatomy, physiology and pathology of the ear and vestibular system, and must be able to:

- Form a diagnosis and rehabilitation plan,
- Participate in multidisciplinary teams in which diagnoses and rehabilitation options are evaluated,
- Supervise and educate other healthcare professionals,
- Communicate with patients in a clear and understandable way, and
- Effectively and efficiently manage patient care, without losing sight of the purpose and suitability of a therapy or treatment.

In short, the MPE must be able to determine what care is necessary, appropriate and sufficient, in the context of multidisciplinary patient care.

Knowledge, skills and competences

The MPE has knowledge of:

- The anatomy, physiology and pathology of the outer, middle and inner ear, and of the vestibular system as well as the innervation of the labyrinth and the pathways to the brain,
- The anatomy of the visual system,
- Speech and language development and the associated disorders,
- Personal and environmental factors influencing the affliction and/or participation capabilities of the patient,
- The psychosocial aspects that can accompany hearing and communication disorders,
- The diagnostic and treatment options provided by the other health care professionals in the multidisciplinary team, and
- The technical and non-technical treatment options.

The MPE is able to:

- Interpret referrals of healthcare professionals and refer patients to other healthcare professionals,
- Conduct an anamnesis,
- Formulate a patient's request for help,
- Formulate a treatment plan based on the diagnostic data.
- Deliver bad news in a compassionate and appropriate manner,
- Inform and counsel patients and discuss treatment options in suitable, clear language and in accordance with their emotional state or state of mind,

- Work with patients with special needs, with an awareness of the guidance and educational possibilities for these patients,
- Provide a recommendation to a patient or insurance company,
- Refer to further care when necessary,
- Maintain a proper patient file, and
- Supervise other members of a multidisciplinary team to carry out the above-mentioned activities.

EPAs
In audiology, each resident has to show to be able to conduct all of the above-mentioned skills in a system of multiple Entrustable Professional Activities (EPAs), comprising different categories of audiological care. These EPAs are listed below and can be found in Appendix V.2:

1. Hearing diagnosis in adults,
2. Hearing rehabilitation and audiological care in adults (mainly via hearing aids or bone conduction devices),
3. Hearing diagnosis in children and infants,
4. Hearing rehabilitation and audiological care in children and infants,
5. Cochlear implants in adults,
6. Cochlear implants in children and infants,
7. Vestibulology,
8. Speech and language development in children, and
9. Tinnitus.

All these EPAs are addressed throughout the four years of training within the standard clinical care of the training institute, using different levels of supervision, working from supervision level 1 to 3, 4 or 5, depending on the EPA.

Levels of supervision:

1. The resident observes (does not act).
2. The resident acts under direct, proactive supervision (supervisor is present).
3. The resident acts under indirect, reactive supervision (supervisor not present, but available when needed).
4. The resident is competent to act without supervision.
5. The resident supervises the activity.

II.1.d. Radiology and Nuclear Medicine

Short description
Advanced knowledge of anatomy, physiology and pathology is required to effectively communicate and operate in a multidisciplinary team in the departments of radiology and nuclear medicine, and to recognise and understand the underlying anatomy, physiology and pathology shown in the images produced by the different modalities.

Knowledge, skills and competences
The Radiology and Nuclear Medicine MPE has knowledge of:

- Various treatment options,
- Radiobiology, including effects of different forms of radiation on cells, differences between external beam radiotherapy, brachytherapy and radionuclide therapy, and the effects of different types of ionising radiation,
- The development of cancer, the nature of the various forms of cancers, and the associated diagnosis and treatment options, including multi-modality options, such as chemotherapy or chemoradiation, surgery, immunotherapy and hormone therapy, as

well as High-Intensity Focused Ultrasound (HIFU), Photo-Dynamic Therapy (PDT), Radio Frequency Ablation (RFA), hyperthermia, radiotherapy and nuclear therapy,
- Fundamentals of cellular, molecular and tumour biology,
- Deterministic and stochastic effects of ionising radiation, and
- Principles of diagnostics and staging of cancer.

The Radiology and Nuclear Medicine MPE is able to:
- Identify the basic anatomy, physiology and pathology of the major parts of the body in images created on all radiology or nuclear imaging modalities,
- Apply a practical understanding of the process of how a radiologist comes to a diagnosis of different pathologies, and
- Translate the questions and challenges facing medical staff into medical physical terms.

The Radiology and Nuclear Medicine MPE is competent to:
- Participate/accompany/observe radiologist while they do their diagnosis and image analysis, for all major anatomic parts and clinical concerns in order to help improving diagnosis.

II.1.e. Radiotherapy

Short description

In order to effectively communicate and operate within the multi-disciplinary team, an understanding of the fundamentals of cancer development, diagnostics and treatment is required. Knowledge of radiobiological principles and the effects of radiotherapy and multimodality treatments is also essential.

Knowledge, skills and competences

The MPE has knowledge of:
- The development of cancer, the nature of the various forms of cancers and their molecular and cellular features, as well as diagnostics of cancer,
- Different tumour sites and treatment options including multi-modality options such as chemotherapy or chemoradiation, surgery, immunotherapy and hormone therapy, as well as alternative or complementary treatment modalities such as High-Intensity Focused Ultrasound (HIFU), Radio Frequency Ablation (RFA) and hyperthermia,
- Radiotherapy treatment options including radiation schemes and clinical outcomes,
- Radiobiological background of treatment strategies in radiation therapy,
- Fundamentals of radiobiological models in radiotherapy, and the application and limitations of these models,
- Dose-response analysis from clinical data and patient cohorts,
- Fundamentals of cellular, molecular and tumour biology,
- Deterministic and stochastic effects of ionising radiation,
- Effects of fractionation, dose rate, radio sensitization and reoxygenation, and
- Principles of diagnostics and staging of cancer.

Deliverables

1. Follow the treatment chain for curative treatment for one individual patient from multidisciplinary tumour board to first treatment fraction including patient consultation.

II.2. Physics and Engineering in Medicine

II.2.a. Common Trunk

Short description

An MPE is an expert on the physics and engineering of medical devices and is aware of possibilities, limitations and pitfalls of their clinical application. The MPE values developments in design and functionality of these medical devices and communicates necessary or desired improvements to vendors/producers. Within the multi-disciplinary team, it is the role of the MPE to ensure that equipment used in the diagnosis or treatment process is used appropriately, effectively and safely. In addition, the MPE understands the acquisition process and interpretation of data from the various modalities.

Knowledge, skills and competences

The MPE has knowledge of:

- Physics and engineering principles of medical devices used for diagnostics, therapy, functional support and patient monitoring in the hospital environment and other medical settings (as described in more detail in sections for the differentiations),
- Anatomical and functional imaging acquired with different modalities and techniques,
- CT, MRI, ultrasound and PET imaging devices, sources of image artefacts, image uncertainties and the resolution limits,
- The physics and principles of the different imaging modalities and the effects of the acquisition and reconstruction parameters on the appearance and the properties of an image,
- Effects and management of patient organ motion in imaging, and
- Image and Data handling, digital image processing, reconstruction algorithms, patient data management systems.

The MPE is able to:

- Participate in technical discussions with engineers (e.g., discussions on recalibration or replacement of parts),
- Participate in discussions with the end-users of the equipment (e.g., discussions on proper usage and technical limitations of usage), and
- Initiate and support training, education and research on medical equipment.

The MPE is competent to:

- Independently perform or participate in acceptance tests/commissioning/calibration for medical devices and medical rooms.

Deliverables

1. Write a recommendation for development/adjustment of a medical device or procedure that is in clinical use.

II.2.b. General Medical Physics

Short description

The General MPE is able to advise management and staff on which type of technique or equipment should (or should not) be procured or used for specific applications. In order to function as an expert and to effectively communicate and operate within a multi-disciplinary team, a thorough understanding of the physics and engineering of medical devices is required. The General MPE is responsible for the safe and effective operation of medical devices. Specific

requirements in medical imaging include optimising image quality in relation to radiation dose, acquisition time or acquisition parameters, and knowledge of state-of-the-art imaging techniques.

All lifecycle phases of medical devices should be fully understood, including selection, room design, acceptance, calibration, safety and quality assurance, optimisation, and decommissioning. Furthermore, the General MPE is capable of initiating and supporting training, education and research and is proactive in giving advice on new applications of medical devices in clinical practice.

Knowledge, skills and competences
The General MPE has knowledge of

- Basic physics principles and working mechanisms, and safety aspects of at least the following devices:
    - Ventilator devices,
    - Monitoring devices,
    - Infusion pumps,
    - Electro surgery,
    - All imaging modalities on radiology and nuclear medicine departments
    - All ultrasound equipment throughout the hospital or institution,
    - All devices used in areas of intensive care and monitoring (ICU, CCU, BCU, ER and OR), and
    - All lasers and ultraviolet radiation equipment.
- Signal analysis algorithms used typically in these devices,
- Signal processing and data acquisition techniques (hard- and software),
- Typical parameters settings of these devices,
- Current state-of-the-art and future developments of medical technology in several medical specialties,
- Principles of interaction between ionising and non-ionising radiation and matter,
- MR safety,
- Operating image acquisition systems,
- Image reconstruction algorithms,
- The effect of imaging parameters on image quality, dose and acquisition time,
- Principles of electrical safety, and
- Principles of medical gas safety.

For detailed descriptions of knowledge, skills and competences on devices used in radiology and nuclear medicine, please refer to Section II 2.3, the section for Radiology and Nuclear Medicine. These descriptions can serve as an inspiration for in-depth projects with a specific device for a resident in General Medical Physics (Dutch: Algemene Klinische Fysica - AKF).

Deliverables

1. Independently perform or participate in acceptance tests/commissioning/calibration for at least 3 medical devices, at least at the following locations: Radiology/Nuclear Medicine, OR/ICU, and Functional Monitoring (e.g. Cardiology or Audiology).
2. Advise in the building/room design requirements, determine electrical safety requirements and perform acceptance tests for medical rooms, specifically concerning Ionising and Electromagnetic radiation protection.

II.2.c. Audiology

Short description

As a leader of the audiological centre and as a caregiver the Audiology MPE needs to have a knowledge of the physics and engineering of the audiological devices that are used for diagnostics and must be aware of possibilities and pitfalls in their clinical application. They also need a thorough understanding of the function and limitations of all types of hearing aids and other devices that support communication. Furthermore, they must be able to administer and adjust these devices and be able to teach others to perform these tasks. They must be able to value developments in design and functionality of these medical devices, and to communicate necessary or desired adjustments to vendors and producers.

Knowledge, skills and competences

The Audiology MPE has knowledge of:

- The physical properties of hearing aids, bone conduction devices and cochlear implants, and how these properties can be used to benefit the patient,
- Appropriate amplification models for hearing aids and bone conduction devices, and how to apply these models in the various devices, and
- Appropriate stimulation models for cochlear implants, and how to apply these models in different implants.

The Audiology MPE is able to:

- Perform and teach the following audiological diagnostic measurements in adults:
    - Pure tone audiometry,
    - Speech audiometry (such as Pure tone, speech and Visual Reinforcement Audiometry),
    - Speech in noise audiometry,
    - Tympanometry and acoustic reflex measurements,
    - Otoacoustic emissions (OAEs), and
    - Brainstem Evoked Response Audiometry (BERA).
- Perform and teach the following specific audiological measurements in children and infants:
    - BERA and Auditory Steady State Responses (ASSR),
    - Otoacoustic emissions (OAEs),
    - Tympanometry,
    - Conditioned Play Audiometry (CPA),
    - Visual Reinforcement Audiometry (VRA),
    - Behavioural Observation Audiometry (BOA),
    - Speech audiometry, and
    - Speech in noise audiometry.
- Perform and interpret performance tests on various hearing aids and bone conduction devices,
- Perform and interpret response measurements on cochlear implants,
- Verify the amplification of hearing aids with Real Ear Measurements (REM), including:
    - Verification of the various output parameters by means of real ear insertion gain, real ear aided gain, real ear aided response, et cetera, and
    - Verification by means of simulated real ear measurements in a 2cc coupler using RECD measurements.
- Validate various hearing devices using:
    - Free field tone- and speech audiometry, and
    - Free field speech in noise audiometry
- Calibrate different audiological diagnostic devices, and
- Measure sound (exposure), room acoustics and speech transmission.

Deliverables

1. Independently perform or participate in acceptance tests/commissioning/calibration of an audiometer and deliver a calibration report.
2. Perform or participate in an acceptance test of a sound booth/audiological consultation room.

II.2.d. Radiology and Nuclear Medicine

The Radiology and Nuclear Medicine MPE is a trained expert in the field of diagnostic imaging and image guided therapy. Besides expert knowledge on the physics and engineering of the components across the imaging chain, the Radiology and Nuclear Medicine MPE has in depth knowledge of the technical and safety requirements of the medical devices used in conjunction to the imaging and therapeutic applications.

The Radiology and Nuclear Medicine MPE:

- Is responsible for safe and effective operation of imaging equipment,
- Is capable of optimising image quality in relation to radiation dose, acquisition time and acquisition parameters,
- Has knowledge of state-of-the-art techniques, and
- Is proactive in advising on new imaging possibilities.

In addition, the Radiology and Nuclear Medicine MPE:

- Plays an important role in training, education and research,
- All lifecycle phases of an imaging modality should be fully understood, including selection, room design, acceptance, calibration, safety and quality assurance, optimisation, and decommissioning,
- Understands and applying the physics and principles of the whole 'imaging chain' for all modalities, that includes acquisition, reconstruction, processing, displaying and post-processing, and
- Understands clinical application of imaging modalities and its role in patientcare.

Deliverables

1. Independently perform or participate in acceptance tests/commissioning/calibration for each of the five large modalities (SPECT/PET/Fluoroscopy/MRI/CT).
2. Perform protocol optimization on a radiological or nuclear imaging modality.
3. Guide the introduction of a software application in the field of RNM (such as AI tool for reconstruction, images analysis project).
4. Deliver education to medical disciplines on image techniques.
5. Advise in the building/room design requirements, determine electrical safety requirements and perform acceptance tests for medical rooms, specifically concerning Ionising and Electromagnetic radiation protection.

Equipment in general

Short description:

Some technology or methodology is used in multiple imaging and therapeutic equipment. This chapter describes the general concepts necessary for a Medical Physicist in the field of Radiology and Nuclear Medicine. For simplicity, all general knowledge, skills and competences for modalities are described in this section leaving only the specific knowledge, skills and competences for the individual modalities.

Knowledge, skills and competences
The Radiology and Nuclear Medicine MPE has knowledge of:

- The physics of all imaging modalities to the level that the resident can teach other medical professions,
- The different applications of each modality,
- The relationships between components of each modality and the contribution of each component in the imaging chain,
- X-ray tubes (including hardware and specifics of x-ray spectra),
- Principles of interaction between radiation and matter,
- The operating principles of different detectors,
- The effects of imaging parameters on image quality, dose and acquisition time,
- Relevant laws, reports and guidelines, and
- Protocols and phantoms for quality control.

The Radiology and Nuclear Medicine MPE is able to:

- Identify and interpret artefacts in images, and advise on the clinical impact and risks and how to these can be mitigated,
- Understand how radiological reporting is done on a broad range of diagnostic questions and modalities: implement with short clinical internships by observing reporting of radiologists,
- Operate image acquisition systems, and
- Advise on the room specifications for safe use of imaging equipment.

The Radiology and Nuclear Medicine MPE is competent to:

- Perform all aspects of the introduction of new imaging equipment, and
- Optimise image quality.

Peripheral Equipment

Short description
Numerous medical devices are involved in the workflow of the departments of radiology and nuclear medicine. The Medical Physics Expert should have enough knowledge and skills to take responsibility for the save utilisation of these devices.

Knowledge, skills and competences
The Radiology and Nuclear Medicine MPE has knowledge of:

- The technology of the equipment used in combination with imaging devices, specifically:
  - Contrast Injectors in different applications (Angiography, CT, MR),
  - Physiological Monitoring: e.g. ECG, heart rate (prospective and retrospective gating), respiration, apnoea, (non) invasive blood pressure, cardiac output, O2-CO2 saturation (e.g. sedation and anaesthesia by MR imaging), temperature monitoring (MR), arrhythmia and telemetry (MR),
- Gamma probes, and
- Dose calibrators.

II.2.d.i. Computed Tomography

Knowledge, skills and competences
The Radiology and Nuclear Medicine MPE has knowledge of:

- The principles, methodologies and algorithms of image reconstruction.

The Radiology and Nuclear Medicine MPE is able to:

- Recognise the differences between and limitations of different CT apparatuses (such as spectral CT, cone-beam CT and conventional CT), and
- Recognise common CT artefacts.

The Radiology and Nuclear Medicine MPE is competent to:

- Optimise patient imaging protocols with respect to image quality, patient radiation- and contrast-dose,
- Advise on common CT artefacts, and
- Create a safe working environment for imaging activities, including CT-guided punctures and biopsies.

II.2.d.ii. Magnetic Resonance Imaging

Knowledge, skills and competences

The Radiology and Nuclear Medicine MPE has knowledge of:

- The physics of MRI signal transmission and detection,
- Acquisition parameters and their effect on the MR image,
- Imaging and contrast effects T1, T2, T2*, PD, DWI, velocity, flow, susceptibility and diffusion,
- Acquisition methods and techniques (including K-space sampling schemes and fast acquisition),
- The principles, methodologies and algorithms of image reconstruction,
- MR technology, including RF-coils, the magnet and gradient systems,
- Different applications, such as diagnosis and therapy planning (radiotherapy, neuro navigation), and
- Principles, classification, safety/risks and use of MR contrast agents.

The Radiology and Nuclear Medicine MPE is able to:

- Advice on a safe MRI-room, including magnetic field containment and Faraday cage,
- To judge MR safety for patient contraindications and 3rd company devices, and
- Recognise common MR artefacts.

The Radiology and Nuclear Medicine MPE is competent to:

- Advice on safe scanning of patients with implants,
- Filling role of MR safety expert in the hospital or institution, and
- Advise on artefacts created by image acquisition and reconstruction.

II.2.d.iii. Positron Emission Tomography (PET/CT)

Knowledge, skills and competences

The Radiology and Nuclear Medicine MPE has knowledge of:

- PET radioisotopes and tracers used,
- Specific PET image reconstruction algorithms and all corrections applied,
- Clinical indications and protocols for PET: oncology, cardiac, neurology, radiotherapy,
- Data acquisition: singles, randoms, noise equivalent count rate, list mode, sinogram mode, and,
- Specific PET image reconstruction items: iterative methods (ML-EM), LOR-reconstruction, Time-of-Flight, Point Spread Function correction. Corrections and pre-processing, corrections for: geometry, normalisation, attenuation, scatter, randoms, dead time, decay, point spread, motion.

The Radiology and Nuclear Medicine MPE is able to:

- Recognise common PET/CT artefacts.

The Radiology and Nuclear Medicine MPE is competent to:

- Advise on artefacts created by image acquisition and reconstruction.

II.2.d.iv. Single-photon emission tomography (SPECT/CT)

Knowledge, skills and competences

The Radiology and Nuclear Medicine MPE has knowledge of:

- SPECT radioisotopes and tracers used,
- Specific SPECT image reconstruction algorithms and all corrections applied,
- Quantification methods in planar and SPECT imaging, and
- Specific SPECT image reconstruction items: Corrections and pre-processing, corrections for geometry, normalisation, attenuation, scatter, dead time, decay, point spread, motion.

The Radiology and Nuclear Medicine MPE is able to:

- Recognise common SPECT/CT artefacts.

The Radiology and Nuclear Medicine MPE is competent to:

- Advise on artefacts created by image acquisition and reconstruction.

II.2.d.v. Isotopes, tracers and the radionuclide laboratory

Short description

At the basis of molecular imaging lie the radiolabelled molecules that mark a specific physiological process of the body.

Knowledge, skills and competences

The Radiology and Nuclear Medicine MPE has knowledge of:

- Isotope production methods: reactor, cyclotron, linear accelerators, generators,
- Properties and applications of the different tracers,
- Tracers synthesis: theory and practical aspects, including quality control,
- Production of positron emitters (F-18 targetry, C-11, O-15, N-13, Ga-68, Rb-82, Cu-61/62/64),
- Dose calibrators: quality control, calibration,
- Practical safety procedures in radionuclide laboratory, incl. relevant guidelines, and
- Regulatory laws and guidelines applicable to production and handling of radioactive tracers in the hospital or institution.

The Radiology and Nuclear Medicine MPE is able to:

- Be an expert in the physical properties of the different radioactive isotopes and tracer-molecules affecting imaging, and
- Be an expert in the dosimetry and the possibilities for quantification.

The Radiology and Nuclear Medicine MPE is competent to:

- Be an expert in the design, work processes and regulations surrounding radionuclide laboratories.

II.2.d.vi. Radiography, mammography, fluoroscopy and bone densitometry

Knowledge, skills and competences

The Radiology and Nuclear Medicine MPE has knowledge of:

- Specific application, indications, benefits and pitfalls,
- Projections, image magnification, scatter and scatter rejection, both digital as with scatter grid,
- The principles, methodologies and algorithms of (tomographic) image reconstruction,
- Differences between conventional, mammography, chest radiography and fluoroscopy,
- Different fluoroscopy configurations (floor, ceiling mounted, mobile, bi-plane C-arms),
- Relation to other fluoroscopy techniques, including:
  - CT fluoroscopy,
  - MR-fluoroscopy,
- Different modes of operation in fluoroscopy (continuous, pulsed, averaging, last frame hold, road mapping, CT-mode),
- Specific resolution requirements in digital mammography, digital tomosynthesis, stereotactic punction,
- Breast cancer screening program and the role of the LRCB,
- Diagnostic reference levels and dose assessment,
- Dual energy x-ray absorptiometry principles,
- Theory and operation of DEXA equipment and the other techniques for bone density estimation: quantitative CT,
- Basic introduction to osteoporosis, bone physiology and risk factors.

The Radiology and Nuclear Medicine MPE is able to:

- Apply these techniques in different labs: genitourinary, peripherical vascular and cardiac angiography, cardiac electrophysiology, neurovascular imaging and interventions, and
- Recognise common artefacts.

The Radiology and Nuclear Medicine MPE is competent to:

- Advise on artefacts created by image acquisition and reconstruction.

II.2.d.vii. Ultrasound

Knowledge, skills and competences

The Radiology and Nuclear Medicine MPE has knowledge of:

- Principle, working mechanism and application of ultrasound,
- The principles, methodologies and algorithms of image reconstruction,
- Transducer techniques and systems,
- Doppler, colour Doppler,
- (Differential) harmonic imaging,
- Contrast agents,
- IVUS, and
- 3D ultrasound.

The Radiology and Nuclear Medicine MPE is able to:

- Recognise common echo artefacts.

The Radiology and Nuclear Medicine MPE is competent to:

- Advise on artefacts created by image acquisition and reconstruction.

II.2.d.viii. Quantitative image analysis and diagnostic monitors

Short description

Quantitative image analysis is an expanding area in radiology and nuclear medicine.
Finally the 'diagnostic imaging chain' ends with displaying the image on a diagnostic monitor and the image perception of the observer. This crucial final step also needs to be fully understood by the Medical Physics Expert.

Knowledge, skills and competences

The Radiology and Nuclear Medicine MPE has knowledge of:

- The underlying principles of image processing techniques applied to medical images,
- Quantification in PET: SUVs, Patlak analysis, input function, tumour tracking software, basics of pharmacokinetic modelling,
- Factors influencing the visual perception of an image on a medical display,
- The difference between displays for primary diagnosis and clinical review,
- The differences between images and display criteria of different modalities (MRI, CT etc), and
- The characteristics of images: compression, post processing, matrix- and pixel- size, bit depth.

The Radiology and Nuclear Medicine MPE is able to:

- Use Computer Aided Diagnoses (CAD), clinical decision support systems and applications of AI in radiology and nuclear medicine,
- Write and test the image processing routines in an interactive programming environment, and effectively apply them to selected clinical problems,
- Make recommendations concerning selection of displays during purchasing process, and
- Make specific recommendations for viewing images of different modalities.

The Radiology and Nuclear Medicine MPE is competent to:

- Perform software validation (for image processing),
- Advise on artefacts created by image acquisition and reconstruction,
- Optimise and validate the quantification of biomarkers, such as:
  - Determination of stenose grade by angiography, ultrasound and CT,
  - Cardiac function by ultrasound, DSA, cardio angiography, cardio CT and MRI,
  - Dynamic contrast enhancement by MRI, CT and ultrasound, and
- Measure and optimise viewing conditions.

II.2.d.ix. Therapy

Short description

The combination of imaging and therapy becomes more abundant. These include therapies using ionising radiation (nuclide therapies, image guided radiotherapy) and therapies based on different physical techniques, e.g. different forms of ablation.
In nuclear medicine radioactive isotopes and tracers are used to target specific regions, organs or cells in the body. These radiopharmacons are used for curing diseases and for palliative therapy.

Ablative treatments are used to achieve optimal coverage of the tumour, while minimising involvement of surrounding tissue. Image guidance, target definition and dose monitoring are common features of all these techniques. An understanding of the relation between tumour cell kill and the probability of achieving local control is essential.

Knowledge, skills and competences

The Radiology and Nuclear Medicine MPE has knowledge of:

- The principles, methodology, techniques and different radionuclides used in radionuclide therapy:
  - Radiopharmaceuticals uptake and retention,
  - Uptake measurements,
  - Calculation of the therapeutic activity and resulting patient dose,
  - Selective internal radiation therapy,
  - Different therapeutic and diagnostic tracers/applications,
  - Dosimetry software tool, and
  - Dose-effects curves of different radiation therapies.
- Different ablation techniques in relation to imaging, including:
  - High-Intensity Focused Ultrasound (HIFU),
  - Radio Frequency Ablation (RFA), and
  - Laser- and Cryo-ablation.
- Understand interventional radiology and cardiology topics:
  - Stenting, and
  - PCI.
- The use of image information in therapeutic treatment planning by other departments, and
- Image guided radiotherapy.

The Radiology and Nuclear Medicine MPE is able to:

- Calculate patient or organ dose,
- Advise on treatment plans for therapies both with ionising radiation and other ablation techniques,
- Taking responsibility for patient individual dosimetry and treatment planning of radionuclide therapies,
- Understand applications for 3D printing in surgical planning,
- Understand use of image information for treatment planning:
  - Neuronavigation,
  - Stereotactic neurosurgery,
  - Radiotherapeutic treatment planning,
  - 3D presentations for surgery, and
  - Orthopaedic planning and image guidance.

The Radiology and Nuclear Medicine MPE is competent to:

- Take responsibility for patient dosimetry and safety, as is specified in Dutch regulations (Bbs), and
- Take responsibility for the safe use of therapy in combination with MR.
- Take responsibility for the safe use of lasers.

II.2.e. Radiotherapy

II.2.e.i. Treatment equipment for external radiotherapy

Short description

The Radiotherapy MPE is responsible for the installation, maintenance, and safe and effective operation and de-installation of all radiotherapy equipment, including the integrated imaging systems to position and localise the target on-line before and/or during the treatment.

Knowledge, skills and competences

The Radiotherapy MPE has knowledge of:

- Physics and principles of radiotherapy treatment units (including linear accelerators, GammaKnife, Cyberknife, proton therapy, MR-linac and orthovoltage systems),
- In-room imaging equipment (including CBCT, kV and MV imaging, MR imaging on the MR-linac, and surface guided radiotherapy),
- Dosimetric and mechanical parameters of the radiotherapy treatment units and their interlocks.

The Radiotherapy MPE is able to:

- Operate treatment units and in-room imaging equipment,
- Communicate with engineers (e.g., concerning recalibration or replacement of parts), and
- Understand the engineering, maintenance and quality control of the treatment and imaging equipment.

The Radiotherapy MPE is competent to:

- Commission treatment machines and decide whether treatment machines can be clinically used.

Deliverables

1. Perform acceptance testing and commissioning of a treatment unit, treatment planning system or imaging modality (MRI, CT) that is used for radiotherapy simulation.

II.2.e.ii. Treatment simulation and planning

Short description

The Radiotherapy MPE plays a key role in the entire treatment planning procedure, both for conventional and online adaptive workflows, and is responsible for the acceptance, commissioning and maintenance of the Treatment Planning System (TPS). The Radiotherapy MPE is responsible for the effective use of CT, MRI and PET devices. The Radiotherapy MPE has expert knowledge of dose calculation and optimisation algorithms.

Knowledge, skills and competences

The Radiotherapy MPE has knowledge of:

- Mould room activities,
- Immobilisation devices, and their applications and accuracies,
- Limitations and artefacts in the use of imaging modalities used in the radiotherapy simulation process, and consequences for treatment uncertainties and quality,
- Hardware and software components and networking of a TPS,
- Algorithms and methods to (optimise and) calculate and evaluate the dose distribution for proton, photon and electron beams,
- Beam modelling in treatment planning systems,

- Uncertainties in dose calculations,
- Photon, proton and electron plans for all treatment sites,
- Techniques to delineate organs at risk, including the use of AI, auto-segmentation and deformable registration, and
- Specification and reporting of dose distributions, target volumes and margins (GTV, CTV, PTV, ITV), according to international recommendations.

The Radiotherapy MPE is able to:

- Apply multimodality imaging data (MRI, PET) and image fusion for target volume delineation,
- Incorporate implanted devices into the treatment plan, including consideration of the effects of high (electron) density materials on the dose calculation,
- Perform an independent check of the individual patient plan, using both pre-treatment dosimetry and a secondary dose calculation system.

The Radiotherapy MPE is competent to:

- Oversee the treatment planning process, and advise on its limitations and the consequences of treatment choices,
- Commission a treatment planning system, including the beam modelling,
- Advise on optimising individual treatment plans,
- Implement a new treatment planning technique, and
- Take responsibility for the dosimetric quality of an individual treatment plan.

Deliverables

1. Participate in the multidisciplinary development of a new treatment planning technique, focusing on clinical constraints, treatment efficiency and safety as well as dosimetric quality.
2. Analyse plans for plan quality and potential pitfalls in delivery.
3. Perform a treatment plan comparison for proton therapy.

II.2.e.iii. External beam treatment delivery, verification and modification

Short description

The Radiotherapy MPE is responsible for all procedures and techniques to verify the different aspects of the treatment, including:

- Patient positioning and target localisation with different image-guided radiotherapy (IGRT) techniques and on-line or off-line correction or plan adaptation protocols,
- Data transfer from the TPS to the treatment unit through the record and verify system, and
- Dosimetric verification of the planned dose distribution.

Knowledge, skills and competences

The Radiotherapy MPE has knowledge of:

- Patient alignment and set-up on the CT/MR and on the treatment unit,
- (pre-treatment) Dosimetric verification of radiotherapy plans,
- IGRT techniques on the treatment unit using MV, kV, CBCT and MRI images and surface scanning to optimise the set-up and target localisation,
- IGRT protocols (such as off-line or on-line imaging, adaptive radiotherapy, plan of the day, and on-line replanning including the use of deformable image registration, dose summation, and workflow possibilities),
- Intra- and inter-fraction set-up errors and target motion,
- Tolerances and action levels, and

- Techniques to account for and minimise respiratory motion during pre-treatment imaging and during treatment.

The Radiotherapy MPE is able to:
- Calculate the treatment (PTV) margin to incorporate the patient setup accuracy,
- Analyse and interpret setup images and the consequences of setup errors during patient treatment, and
- Analyse and interpret dosimetric verification measurements and judge the relevance for patient treatment.

The Radiotherapy MPE is competent to:
- Take responsibility for the continuation of the patient treatment at the treatment machine in case of deviations from the planned situation.

Deliverables
1. Advise on used PTV margins or robust treatment planning procedure for a radiotherapy treatment based on literature, measurements and calculations.

II.2.e.iv. Brachytherapy

Short description

Brachytherapy is a radiotherapy technique that uses sealed radioactive sources that are placed inside or close to the tumour. The Radiotherapy MPE is responsible for the correct use of dosimetry protocols, applicators, measurement systems and brachytherapy TPS.

Knowledge, skills and competences

The Radiotherapy MPE has knowledge of:
- After loading systems and low-dose rate permanent seed implant systems,
- The clinical application of imaging for brachytherapy,
- The source calibration equipment, and relevant quality control procedures,
- Treatment planning for various sites, including gynaecology and prostate,
- The reconstruction of the brachytherapy needles on images and the influence of uncertainties on the dose distribution, and
- Basic radiation safety procedures, such as leakage tests on the sources, disposal of sources, prevention of source loss and action in case of source loss.

The Radiotherapy MPE is competent to:
- Take responsibility for the dosimetric accuracy of the treatment plan.

Deliverables
1. Be present during the preparation and treatment of one patient treated with 3D image-guided brachytherapy (e.g., prostate, cervix), including presence at the operating room.
2. Be present at a source replacement by the company, perform a measurement of the source activity and import this activity in the TPS.

II.3. Risk Management, Quality Control and Safety in the Medical Environment

II.3.a. Common Trunk

Short description

Quality management requires an organisational structure (quality system) in which responsibilities, procedures, processes and resources are clearly defined. The quality system must be compliant with all the requirements of (inter)national legislation and accreditation and requires the development of a formal quality assurance program that details the quality assurance policies and procedures.
The MPE assesses the impact of many (potential) radiological, electrical, chemical, mechanical and biological hazards to patients and staff and is responsible for the quality management of medical equipment.

Knowledge, skills and competences

The MPE has knowledge of:

- Principles of safety and risk management,
- Electrical, electro-magnetic, MR, optical, acoustic and mechanical safety,
- The safety management system (Dutch: Veiligheid Management System – VMS) in place at the hospital or institution,
- National and international guidelines and regulations (such as the Dutch “Veilige Toepassing van Medische Technologie in de Medisch specialistische zorg” and the Medical Device Regulation) [8, 9],
- Quality management systems, records, audits and improvement in quality,
- Different methods of investigation following an incident to analyse its causes and consequences, and design changes to practice to avoid repetition, and
- The life cycle of medical equipment.

The MPE is competent to:

- Organise quality control and quality assurance programs.

Deliverables

1. Participate in a quality control program for a medical device or clinical procedure.
2. Participate in incident management, e.g., by analysing a recent incident or joining the department incident management committee.
3. Perform a prospective or retrospective risk analysis for existing or new equipment or treatment technique.

II.3.b. General medical physics

Short description

The General MPE is able to act as the key person on the safe use of medical technology in a hospital or institution.

Knowledge, Skills and Competences:

The General MPE has knowledge of:

- Electrical safety of rooms and safety classes,
- Electrical safety of medical devices according to IEC 60601,
- Maintenance protocols,
- Cleaning, disinfection and sterilisation of medical devices,

- Recall procedures,
- Standards for quality procedures for medical devices (such as ISO 9001 and ISO 13485), and
- Specific standards, procedures and protocols in the field of acceptance, and status testing (such as reports from the IEC, AAPM, IPEM and QC Light and WAD protocols).

The General MPE is able to:

- Establish a maintenance scheme,
- Increase quality, and implement new technology and systems, and act on organisational changes and dynamics,
- Plan and overview the installation of a new medical device and communicate with the local building manager and/or facility management and manufacturer or local representative,
- Contribute to protocols to maintain or improve safe working conditions,
- Assess, or contribute to the assessment of, the level of competence that is required to safely operate medical devices,
- Define quality measures for safe and effective uses of medical devices throughout the hospital or institution,
- Conduct a patient-related incident analysis on different levels,
- Contribute effectively to a multi-disciplinary risk analysis covering the physics aspects,
- Perform audits to monitor compliance with national legislation and agreements on medical technology, and
- Assess changes in the national legislation on medical technology and its use and analyse the implications for the organisation and its quality management system.

Deliverables

1. (re)Write, implement or follow-up at least one local guideline on quality management or closely related item,
2. Perform or participate in at least one audit or safety check of a department in which a lot of medical equipment is used,
3. Participate in solving artefacts, and
4. Participate in image protocol optimisation for at least one type of radiological or nuclear imaging equipment.

II.3.c. Audiology

Short description

The Audiology MPE is responsible for the care provided in the audiological centre, meaning that they should be able to manage the care that is provided and take responsibility for ensuring that all equipment complies with health and safety regulations, and that all healthcare professionals are well trained. Furthermore, they need to monitor the quality and safety of equipment and of the care patients receive. They should continuously monitor and improve quality and safety of both the equipment and the content and organisation of the clinical care, and know how to handle incidents, including how to analyse them and take appropriate action to prevent them from reoccurring in the future (i.e. have knowledge of PDCA cycles).

Knowledge, skills and competences

The Audiology MPE has knowledge of:

- NEN and ISO norms regarding audiology, and
- The adverse effect of noise exposure on the auditory system.

The Audiology MPE is able to:

- Advise and counsel patients about the possible adverse effects of noise exposure, with particular consideration of work-related issues,
- Take responsibility for patient safety, the appropriate use of equipment and the quality and safety of the audiological care that is given,
- Write, optimise and maintain rules of conduct, clinical operations or procedures of audiological care, and
- Safely manage patient information according to the relevant legislation.

II.3.d. Radiology and Nuclear Medicine

Short description

The imaging and therapeutic modalities that use x-ray, radionuclides, MRI and ultrasound are categorised as high-risk medical equipment because of the potential direct physical risks (mechanical, radiation, heating) for patients and employees and the risk of incorrect diagnosis in case of malfunctions and artefacts. Therefore, it is important to implement and maintain a quality assurance programme. The Radiology and Nuclear Medicine MPE plays a central role in the establishment and implementation of a quality assurance programme as a specialist in this field.

Knowledge, skills and competences

The Radiology and Nuclear Medicine MPE has knowledge of:

- The difference between quality protocols that test for the consistency (Dutch: Constantheidstesten) and in-depth quality protocols,
- Optimisation of patient safety, quality and cost,
- Calibration and use of equipment and phantoms,
- General legislation in the field of quality, including Good Laboratory Practice (GLP), ISO certification, the Quality Act, and the Nuclear Energy Act, and
- Specific procedures and protocols in the field of acceptance, and status tests (such as reports from the IEC, AAPM and IPEM and QC Light and WAD protocols).

The Radiology and Nuclear Medicine MPE is able to:

- Establish a quality assurance programme for the whole imaging department,
- Communicate with technicians, technologists and physicians on quality assurance and maintenance, and supervise quality control testing,
- Determine the clinical relevance of artefacts and surpassed quality criteria,
- Apply and understand different metrics and parameters used for image quality evaluation, such as homogeneity, contrast, detail, DQE, MTF, NPS, SNR, CNR, SSIM, DICE, and MAE,
- Make a risk assessment based on the physical properties of the equipment used and the quality programme in place,
- Perform acceptance testing, commissioning and quality control of all the RNG imaging equipment,
- Advice on a safe MRI-room, including magnetic field containment and Faraday cage, and
- To judge MR safety for patient contraindications and 3rd company devices.

The Radiology and Nuclear Medicine MPE is competent to:

- Take appropriate measures based on risk assessment and the results of the quality programme,

- Perform PET quality testing and assure guidelines: procedure guidelines nuclear medicine Dutch society of nuclear medicine, NEMA-NU2, NEMA-NU4, EARL-accreditation,
- Perform SPECT quality testing and assure guidelines: procedure guidelines nuclear medicine Dutch society of nuclear medicine, NEMA-NU1,
- Setup quality control program for diagnostic displays,
- Advice on safe MR scanning of patients with implants, and
- Filling role of MR safety expert in the hospital or institution.

Deliverables

1. Evaluate a radiological or nuclear imaging QC policy and give advice on addition/removal of QC tests.
2. Perform a risk analysis for the introduction of an image guided intervention.
3. Handle individual cases of patients with implants who are referred for an MRI scan.

II.3.e. Radiotherapy

Short description

Risk management and quality control is one of the main responsibilities of the Radiotherapy MPE. The MPE develops and oversees quality control programs for radiotherapy equipment and is responsible for dosimetric quality assurance and the risk management for the complete radiotherapy dose delivery chain.

Knowledge, skills and competences

The Radiotherapy MPE has knowledge of:

- Quality control programs of radiotherapy treatment devices, and
- Incident and near incident management systems.

The Radiotherapy MPE is able to:

- Analyse incidents and near incidents,
- Perform patient dose measurements, and
- Perform quality control measurements.

The Radiotherapy MPE is competent to:

- Take responsibility for the quality assurance of medical equipment at the radiotherapy department, and
- Decide about clinical use of equipment after preventive or corrective maintenance.

II.4. Radiation Physics, (Radiation) Protection and Dosimetry

II.4.a. Common Trunk

Short description

The MPE often plays a key role in radiation protection and dosimetry, ensuring the radiation safety of patients. These MPE's know the biological effects of radiation for exposed individuals, the relevant regulations, methods of compliance and record keeping, and are qualified to assess the radiation risk, optimise medical exposures, and apply the ALARA and dose limitation principles in the design of radiation therapy facilities, treatment protocols and imaging protocols.
In some cases, the MPE has the role of the Radiation Protection Expert (Dutch: Coördinerend Deskundige) and is also responsible for ensuring the radiation safety of staff and the general public. These MPE's are also responsible for the application of legal regulations (such as licences for the department). The resident therefore should acquire expertise on dosimetry of personnel, the risks of radiation, and the relevant guidelines.

Knowledge, skills and competences

The MPE has knowledge of:

- Radiation protection, ionising radiation and non-ionising radiation (such as microwave, RF and magnetic fields, ultraviolet and laser light, and ultrasound),
- Generation and physical interactions of ionising radiation,
- Biological effects of different types of radiation on various tissues,
- Principles of radiation safety procedures, and
- The physics and techniques of radiation detection systems.

The MPE is able to:

- Optimise medical exposure to radiation,
- Select equipment required to perform radiation protection measurements,
- Optimise radiation protection of patients and other individuals exposed to medical radiation, including the determination and use of diagnostic reference levels,
- Estimate measurement uncertainties, counting statistics and detection limits,
- Apply principles of patient dosimetry with radiological x-ray sources,
- Implement the local regulations of radiation protection,
- Apply the relevant (inter)national guidelines, and
- Implement diagnostic reference levels (DRLs).

The MPE is competent to:

- Train practitioners and other staff in relevant aspects of radiation protection,
- Advise a practitioner or patient after an incident related to ionising radiation, and
- Advise a physician or patient about the risks of exposure to ionising radiation.

Deliverables

1. The relevant national course for Radiation Protection Expert (Dutch: Coördinerend deskundige (AKF, RNG, RTH) of Toezichthoudend Medewerker Stralingsbescherming – Medische Toepassingen (AUD)) should be successfully completed.
2. At least one of the following items:
    a. Perform a radiation survey of an area using appropriate dose-rate equipment,
    b. Study or perform practical design calculations for a room in which ionising radiation will be used,
    c. Plan and practice contingency measures, such as for a lost radiation source or spill,

d. Discuss decontamination procedures after a spill of liquid radionuclide with practitioners or patients,
e. Join the local Radiation Protection Commission of your department or institute,
f. Join the local medical ethics committee as an advisor on the use of ionising radiation in human research, or
g. Compose or assist in composing a permit application for radiation protection (Dutch: Vergunningsaanvraag ANVS).

II.4.b. General medical physics

Short description

In some cases, the General MPE has the role of the Radiation Protection Expert (Dutch: Coördinerend deskundige) of a general hospital or institution. The resident therefore should acquire expertise on dosimetry of personnel, the risks of radiation, and the relevant guidelines.

Knowledge, Skills and Competences

The General MPE is able to:

- Interact with the Labour Inspection (Dutch: Arbeidsinspectie) and the radiation protection authority (Dutch: Autoriteit Nucleaire Veiligheid en Stralingsbescherming – ANVS) regarding compliance to the regulations under the Nuclear Energy Act (Dutch: Kernenergiewet),
- Manage the Nuclear Energy / radiation protection regulations (Dutch: Kernenergiewet dossier) of a hospital or institution,
- Calculate radiation protection requirements in facilities that use ionising radiation,
- Demonstrate a good understanding of the fundamental theoretical and practical aspects of dosimetry,
- Calculate the patient dose after unintended exposure of a patient to ionising radiation from medical radiological equipment,
- Estimate the foetal dose from an unintended exposure of a pregnant patient to ionising radiation from medical radiological equipment,
- Provide travel advice to a patient receiving nuclear medicine therapy, and
- Understand the role the MPE plays when a pregnant patient requires a radiologic exam at the Radiology or Nuclear Medicine department and provide advice to clinicians.

II.4.c. Audiology

No additional (KSC) requirements to common trunk.

II.4.d. Radiology and Nuclear Medicine

Short description

In some cases, the Radiology and Nuclear Medicine MPE has the role of the Radiation Protection Expert (Dutch: Coördinerend deskundige) of a general hospital or institution. The resident therefore should acquire expertise on dosimetry of personnel, the risks of radiation, and the relevant guidelines.

The MPE should be capable of selecting and using the different measurement systems and software tools for dosimetry and quality control. This includes acceptance testing, calibration and quality control of these measurement systems as well as estimation of the (statistical) uncertainty of measurements.

Note: The topic of patient dosimetry is specified in detail in chapter 3 of the Radiology and Nuclear Medicine curriculum.

Knowledge, skills and competences
The Radiology and Nuclear Medicine MPE is competent to:

- Determine appropriate treatment activity and calculate radiation dose for patients pre- and post-treatment,
- Implement a new therapeutic or diagnostic application (such as a dosimetry method or safety protocols),
- Demonstrate a good understanding of the fundamental theoretical and practical aspects of dosimetry,
- Apply principles of patient internal dosimetry with radioactive tracers (MIRD),
- Apply principles of dosimetry for personnel,
- Use software tools to calculate patient dose for both external x-ray sources and internal and external radioactive tracers, and
- Take responsibility for absolute and relative dosimetry in the radiology and nuclear medicine department.

Deliverables

1. Perform dosimetry calculations for radionuclide therapy.
2. Perform dosimetry calculations for radiological and radionuclide imaging.
3. Independently fill a QC phantom with radionuclides and perform the decontamination procedures after a spill of liquid radionuclide.

II.4.e. Radiotherapy

Short description
Accurate dose assessment is an essential task of the radiotherapy medical physics group. The Radiotherapy MPE is responsible for the delivered dose and the correct use of dosimetry devices and protocols. The Radiotherapy MPE oversees the calibration chain from the national primary standard to the hospital field instruments and understands the physics, techniques, and clinical use of the different dosimetry detectors involved. Determination of the absolute absorbed dose for a clinical beam under reference conditions by applying the (inter)national dosimetry protocol is a key responsibility. The Radiotherapy MPE comprehends the methods for determination of dose in non-reference conditions.

Knowledge, skills and competences
The Radiotherapy MPE has knowledge of:

- Interaction of photons, protons, and electrons in matter,
- Fundamentals of absorbed dose and KERMA,
- Fundamentals of reference dosimetry for megavoltage photon and electron beams and for brachytherapy sources and proton beams,
- National (NCS) and international codes of practice for the determination of absorbed dose to water, and
- Dosimetric and measurement uncertainties through the complete dose delivery chain.

The Radiotherapy MPE is able to:

- Perform absorbed dose measurements in clinical situations,
- Select the most appropriate detector for measurement of absolute dose and relative dose distributions under different irradiation conditions,
- Set up a program for acceptance testing, calibration and quality control of the measurement systems,
- Calibrate ionisation chambers, and
- Acquire beam data for the treatment planning system.

The Radiotherapy MPE is competent to:

- Take responsibility for the absolute and relative dosimetry in the radiotherapy department.

Deliverables

1. Participate in an external dosimetry audit.

II.5. IT and data science

II.5.a. Common Trunk

Short description
The MPE understands the role and importance of Information Technology (IT) in the clinical field. The MPE knows the main systems for information sharing, storage, and retrieval in a hospital or institution and of the formats for medical data. The MPE advises on the use of medical equipment within the hospital or institution IT system, on the use of applications such as a Patient Data Monitoring System (PDMS) or the Picture Archiving and Communication Systems (PACS), on an electronic patient record (EPR), or on the use of a patient monitoring system.
Knowledge of general IT-security regulations for collection, storage and transmission and data protection legislation, such as the General Data Protection Regulation (Dutch: Algemene Verordening Gegevensbescherming – AVG) is mandatory, as well as an understanding of the role and responsibilities of the Chief (Medical) Information Officer (CIO and CMIO) of the institute.

The MPE has knowledge of data processing, Big Data handling and Artificial Intelligence (AI), and the methods applied in commercial or in-house developed products, in order to be able to be responsible for the safe and optimal use of these products and to set up quality control programmes. In his or her work the MPE relates to management of information, (data)networks and systems.

Knowledge, skills and competences
The MPE has knowledge of:

- PACS, the hospital or institution information system, PDMS, standards in medical data such as IHE, DICOM and HL7, ICT security standards for collection, storage, transmission and protection of data,
- Data safety (e.g., protected sub-nets),
- The basics and applications of Big Data analyses and artificial intelligence (including Deep Learning),
- Electronic Health Record systems, and
- Privacy procedures.

The MPE is able to:

- Use basic programming skills,
- Establish and operate a quality control programme for the safe use of medical software,
- Establish the implementation of a medical device within the hospital or institution IT system, and
- Test and accept software that is part of or connected to a medical device.

II.5.b. General Medical Physics

Short description
Digital communication, storage and distribution is increasingly relevant to the General MPE. Images and data need to be transferred stored and accessed, but also connected with the patient's electronic health record (the Electronic Patient Dossier - EPD).

Knowledge, skills and competences:
The General MPE has knowledge of:

- The digitization process, workflow and storage throughout the hospital or institution,
- Data-compression techniques and their potential effects on image degradation,

- Specific application of machine learning on image reconstruction, processing and analysis, and
- Software validation dedicated workstations, server-client, different combinations of modalities and processing software.

The MPE is able to:

- Write programs or scripts to handle data and to process and analyse images and DICOM headers.

Deliverables

1. Perform an acceptance test/commissioning/calibration of medical software (such as AI).
2. Participate in an ICT project, e.g., PACS, VNA, etc.

II.5.c. Audiology

Short description

In audiology, data must be accumulated from various diagnostic devices and integrated within the electronic patient file. The Audiology MPE is ultimately responsible for all (diagnostic) audiological data and the safe and secure representation of the data within the (electronic) patient file.

Hearing aid manufacturers develop both digital algorithms to improve speech detection and speech discrimination for a variety of listening conditions as well as software for fitting hearing aids and medical implants. The MPE-audiology has to understand the possibilities and limitations of data-driven digital sound processing regarding the needs of the patient and the benefits claimed by the manufacturer.

Knowledge, skills and competences:

The Audiology MPE is able to:

- Design of and advise on a safe representation of audiological data in the electronic patient files.

II.5.d. Radiology and Nuclear Medicine

Short description

Digital image communication, storage and distribution are increasingly relevant for the MPE. Images need to be transferred stored and accessed, but also connected with a patient's individual electronic health record (the Electronic Patient Dossier - EPD).

Knowledge, skills and competences:

The Radiology and Nuclear Medicine MPE has knowledge of:

- Data-compression techniques (lossless and lossy) and their potential image degradation effects, and
- Structured versus non-structured data in reporting results.

The Radiology and Nuclear Medicine MPE is able to:

- Write programs or scripts to handle data and to process and analyse images and DICOM headers, and
- Perform software validation: dedicated workstations, server-client, different combinations of modalities and processing software.

The Radiology and Nuclear Medicine MPE is competent to:

- Establish hospital or institution-wide policies for image storage and routing.

Deliverables

1. Perform an ICT project in the area of RNM (e.g. PACS, Portals, VNA, transmural image exchange).

II.5.e. Radiotherapy

Short description

In a Radiotherapy department, a large amount of data is generated that must be rapidly available during and after treatment.

Knowledge, skills and competences:

The Radiotherapy MPE has knowledge of:

- The DICOM RTH standard,
- Dedicated IT systems for Radiotherapy (such as systems for RTH logistics and Record and Verify systems),
- Backup solutions for dedicated Radiotherapy IT,
- The role of AI in image generation, image reconstruction and image interpretation,
- The role of AI in image segmentation and treatment planning, and
- The role of AI in treatment (outcome) prediction.

The Radiotherapy MPE is able to:

- Write programs or scripts to handle data and to process and analyse images and DICOM headers.

II.6. Organisation, management, finance, laws and ethics in healthcare

II.6.a. Common Trunk

Short description
The basic principles of healthcare finance, laws and medical ethics are an important framework for acting in a clinical setting. The MPE negotiates financial matters with the hospital or institution directors, and health care insurance companies, and discusses ethical dilemmas.

Knowledge, skills and competences
The MPE has knowledge of:

- The structure of the national healthcare system,
- Financial aspects of the healthcare system, and health insurance,
- Hospital or institution management,
- Departmental and/or hospital or institution-wide financial plans,
- Purchasing policy and European tenders,
- Privacy legislation,
- National healthcare legislations (e.g., WGBO, WMO, Wet Medische Hulpmiddelen, wet BIG),
- Intellectual property regulations,
- Ethical considerations in medical research, and
- Medical Ethics Committees.

The MPE is able to:

- Prepare a business case for purchase of new equipment including the total cost of ownership, and
- Work as part of a team to purchase and install new equipment.

II.6.b. General Medical Physics

No additional (KSC) requirements to common trunk.

Deliverables

1. Participate in the investment advisory process of the department or institute,
2. Participate in the procurement process (including procurement, installation, testing and implementation) of a new medical device or medical software as part of a multidisciplinary team.
3. For at least three medical devices, at the departments RadNG, OR/ICU, and Functional Monitoring (e.g. Cardiology or Audiology) a General Medical Physics resident should:
    a. Advise during a complete business case, cost-benefit-analysis, request for proposal,
    b. Provide training to physicians, nurses or technicians for at least one type of medical equipment.

II.6.c. Audiology

Short description
In the Dutch healthcare system, the Audiology MPE is ultimately responsible for the audiological care provided to patients. It is the MPE's responsibility that the care the centre provides is in accordance with rules, regulations and guidelines. To this end they should understand various

aspects of the national healthcare system and how audiological care is financed, be able to consider ethical aspects and have excellent communication skills.

Knowledge, skills and competences
The Audiology MPE has knowledge of:

- The relevant guidelines of the NVKF, FENAC and KNMG,
- The NOAH protocol,
- The restitution policy of insurance companies, and
- Finance of audiological healthcare.

The Audiology MPE Is able to:

- Take responsibility for the management and content of the care that is provided, which should be in accordance with the latest developments and with consideration for the financial aspects, and
- Maintain professional relationships with relevant care partners (such as hearing-aid dispensers and health care companies).

II.6.d. Radiology and Nuclear Medicine

Knowledge, skills and competences
The Radiology and Nuclear Medicine MPE is able to:

- Advise on preparation of a tender,
- Write a request for proposal for purchasing a new imaging device,
- Specify, justify and rank the criteria for selecting new imaging devices, and
- Negotiate with vendors.

Deliverables

1. Participate in the investment advisory process of the department or institute,
2. Participate in the procurement process (including procurement, installation, testing and implementation) of a new medical device or medical software as part of a multidisciplinary team.

II.6.e. Radiotherapy

No additional (KSC) requirements to common trunk.

Deliverables

1. Participate in the investment advisory process of the department or institute,
2. Participate in the procurement process (including procurement, installation, testing and implementation) of a new medical device or medical software as part of a multidisciplinary team.

II.7. Science and Innovation

Short description

The MPE plays a central role in science and innovation in medical technology. The MPE is responsible for initiating innovations as well as performing and initiating scientific research. The MPE translates clinical problems into scientific questions and translates scientific results into clinical innovations. The MPE can critically and objectively evaluate published research results. To prepare the MPE for these tasks, a research project is undertaken during the training program, 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).
Research should be well structured, well defined and clinically relevant. Research should be performed under supervision of an experienced scientist, preferably in a multidisciplinary research group with regular research meetings and group presentations, in order to expose the resident to other research methods and topics.
Research should be carefully planned to identify a specific research topic and formulate a clear research question in the first year of the training. Essential steps such as approval of the Institutional Review Board, access to clinical data and availability of equipment should be met in the second year of the training. It is recommended that at the end of year three a scientific report is ready for peer review. Regular reporting of the progress of the research project(s) in the progress report is advised.
Note: many institutes have certain requirements when performing research (e.g., BROK, GCP).

Knowledge, skills and competences

The MPE has knowledge of:

- Ethical and privacy regulations for scientific research,
- Fundamentals of biostatistics and statistical tests,
- Computational techniques and software packages for statistical data analysis,
- Meta-analysis and medical big data studies, and
- Regulations on intellectual property.

The MPE is able to:

- Design a clinical or technical study to improve diagnostic and treatment techniques,
- Write an application for approval by the medical ethical committee,
- Review scientific literature,
- Design an experiment and collect data,
- Analyse and interpret experimental results,
- Evaluate the impact of innovative diagnostic and treatment techniques,
- Perform or analyse studies of patient outcomes (such as survival data, complication rates or patient reported outcomes),
- Present results from scientific research, and
- Report scientific results.

The MPE is competent in:

- Translating scientific results into clinical innovations, and
- Translating clinical problems into scientific questions.

Deliverables

1. Peer-reviewed paper as a first author or an oral presentation at an International Congress (with peer-reviewed abstract submission) as presenter. This is required by law, Staatsbesluit [6]. Also refer to “Praktische uitwerking van de eis tot wetenschappelijke vorming binnen de opleiding tot klinisch fysicus” on www.stichtingokf.nl.

2. Attend at least one international scientific conference, e.g. ESTRO, ECMP, ASTRO, AAPM, EANM, RSNA, ECR, ISMRM, EFAS.

III. CanMEDS-roles

III.1. Medical Physics Expert

'Medical Physics Expert' is the central role and integrates the other six roles. 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, are part of this role. Furthermore, the MPE has a broad knowledge about physiology and pathology and up-to-date diagnostic, therapeutic and rehabilitation skills to enable the MPE to collect and interpret relevant data.

The MPE must demonstrate and apply knowledge in clinical practice through skills and appropriate attitude. At the end of the residency the MPE should be able to:

- Apply physics and medical standards in their department,
- Take responsibility for quality management of medical technology,
- Take responsibility for innovation and clinical implementation of (new) medical technology for patient treatment or diagnostics, and
- Advise on, contribute to, and take responsibility for the quality of the diagnosis or treatment of an individual patient.

In some cases the MPE is responsible for diagnosis and treatment of patients. In this case the MPE is capable of diagnosing the relevant pathology and initiating evidence-based treatment, and takes full responsibility for diagnosis and follow-up.

III.2. Collaborator

In order to secure the best possible healthcare for the patients, the MPE is able to work in a multi-disciplinary team that includes physicians, medical physicists, paramedical staff, computer scientists, medical engineers, clinical technologists and administrators. This multi-disciplinary approach extends to collaboration with researchers, management of the institute, other healthcare professionals and representatives of the industry. Therefore, the MPE is able to participate in organising 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.

III.3. Communicator

The MPE is able to communicate in an effective, appropriate and unambiguous manner, with patients and healthcare professionals, to ensure the safe and accurate provision of healthcare services. These communication skills include communication of accurate scientific and non-scientific information, in both oral and written form, within the department, and with other departments and/or staff, colleagues, vendors, other professionals in the industry and the general public.

The MPE, especially when treating patients,

- Maintains relations with the patient and discusses the outcomes of diagnostic data and treatment options,
- Is able to give information to the patient (and their carer),
- Is able to give information to professionals and answer their questions, and
- Is able to use non-scientific language whilst ensuring clear and understandable information is given,

- Is able to communicate Dutch on a B2+ level of the Common European Framework of Reference for Languages, in agreement with the level required for BIG registration https://www.bigregister.nl/buitenlands-diploma/ procedures/verklaring-vakbekwaamheid/nederlandse-taalvaardigheid

III.4. Health Advocate

The MPE acts as a Health Advocate to positively influence the healthcare and healthcare organisations for patients and society. The MPE should:

- Understand, and be able to act within, relevant national legal frameworks, regulations and guidelines,
- Be able to act according to the best use of resources in the interest of the patient and society,
- Be able to take adequate action (within their own competency limitations) in response to incidents/accidents,
- Show consideration for the ethical, religious, cultural and moral values of others,
- Demonstrate knowledge of ethical considerations in medical practice, and
- Know the relevant national and European healthcare legislation and guidelines and act accordingly.

III.5. Leader

The MPE:

- Manages and coordinates projects in an interdisciplinary team, both at the level of the department and at institute level,
- Advises staff and directors concerning routine medical physics services, the strategic policy of the specific department, and new developments, and
- Is able to relate department affairs (such as personnel, investments and finance) to the organisation of the institute and the organisation of healthcare in general.

In some cases the MPE is responsible for diagnosis and treatment of patients. In this case the MPE is able to manage patient flows and waiting lists.

III.6. Professional

The MPE has a high standard of professionalism and integrity, self-awareness and awareness of limitations of knowledge and competences, as well as high standards of ethical and moral behaviour, reliability and responsibility, respect for patient dignity, and autonomy.

The MPE

- Acts in accordance with medical ethical values in order to address dilemmas in the clinical environment,
- Knows the relevant laws for health care. Patient treatment and diagnosis is preferably evidence-based.
- Organises and performs safety and risk management, registers incidents systematically, and initiates corrective actions.

III.7. Scholar

The field of medicine and medical physics is a dynamic, quickly evolving discipline. The MPE:

- Is able to develop, perform, and supervise research and innovation, and publish and present the research data,

- Is responsible for the introduction and implementation of new advanced diagnostic and treatment technologies along with optimisation of existing techniques,
- Should have a good national and international network and broad scientific interests, and endeavour to constantly learn and acquire new knowledge, and
- Is able to teach and train residents as well as other professionals in his or her field of expertise.

IV. References

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www.nvkf.nl
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[4] European Federation of Organisations for Medical Physics,
www.efomp.org
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www.aapm.org
[6] Staatsblad: Besluit opleidingseisen en deskundigheidsgebied klinisch fysicus,
http://wetten.overheid.nl/BWBR0018235/
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[10] CanMEDS 2015 Physician Competency Framework,
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V. Appendices

V.1. Deliverables

V.1.a. Common Trunk

2. Physics and Engineering in Medicine

1. Write a recommendation for development/adjustment of a medical device or procedure that is in clinical use.

3. Risk Management, Quality Control and Safety in the Medical Environment

1. Participate in a quality control program for a medical device or clinical procedure.
2. Participate in incident management, e.g., by analysing a recent incident or joining the department incident management committee.
3. Perform a prospective or retrospective risk analysis for existing or new equipment or treatment technique.

4. Radiation Physics, (Radiation) Protection and Dosimetry

1. The relevant national course for Radiation Protection Expert (Coördinerend deskundige (AKF, RNG, RTH) or Toezichthoudend Medewerker Stralingsbescherming – Medische Toepassingen (AUD)) should be successfully completed.
2. At least one of the following items:
    a. Perform a radiation survey of an area using appropriate dose-rate equipment,
    b. Study or perform practical design calculations for a room in which ionising radiation will be used,
    c. Plan and practice contingency measures, such as for a lost radiation source or spill,
    d. Discuss decontamination procedures after a spill of liquid radionuclide with practitioners or patients,
    e. Join the local Radiation Protection Commission of your department or institute,
    f. Join the local medical ethics committee as an advisor on the use of ionising radiation in human research, or
    g. Compose or assist in composing a permit application for radiation protection (Dutch: Vergunningsaanvraag ANVS).

7. Science and Innovation

1. Peer-reviewed paper as a first author or an oral presentation at an International Congress (with peer-reviewed abstract submission) as presenter. This is required by law, Staatsbesluit [6]. Also refer to “Praktische uitwerking van de eis tot wetenschappelijke vorming binnen de opleiding tot klinisch fysicus” on www.stichtingokf.nl
2. Attend at least one international scientific conference, e.g. ESTRO, ECMP, ASTRO, AAPM, EANM, RSNA, ECR, ISMRM, EFAS.

V.1.b. General Medical Physics

2. Physics and Engineering in Medicine

1. Independently perform or participate in acceptance tests/commissioning/calibration for at least 3 medical devices, at least at the following locations: Radiology/Nuclear Medicine, OR/ICU, and Functional Monitoring (e.g. Cardiology or Audiology).

2. Advise in the building/room design requirements, determine electrical safety requirements and perform acceptance tests for medical rooms, specifically concerning Ionising and Electromagnetic radiation protection.

3. Risk Management, Quality Control and Safety in the Medical Environment

1. (re)Write, implement or follow-up at least one local guideline on quality management or closely related item,
2. Perform or participate in at least one audit or safety check of a department in which a lot of medical equipment is used,
3. Participate in solving artefacts, and
4. Participate in image protocol optimisation for at least one type of radiological or nuclear imaging equipment.

5. IT and data science

1. Perform an acceptance test/commissioning/calibration of medical software (such as AI).
2. Participate in an ICT project, e.g., PACS, VNA, etc.

6. Organisation, management, finance, laws and ethics in healthcare

1. Participate in the investment advisory process of the department or institute,
2. Participate in the procurement process (including procurement, installation, testing and implementation) of a new medical device or medical software as part of a multidisciplinary team.
3. For at least three medical devices, at the departments RadNG, OR/ICU, and Functional Monitoring (e.g. Cardiology or Audiology) a General Medical Physics resident should:
    a. Advise during a complete business case, cost-benefit-analysis, request for proposal,
    b. Provide training to physicians, nurses or technicians for at least one type of medical equipment.

V.1.c. Audiology

2. Physics and Engineering in Medicine

1. Independently perform or participate in acceptance tests/commissioning/calibration of an audiometer and deliver a calibration report.
2. Perform or participate in an acceptance test of a sound booth/audiological consultation room.

V.1.d. Radiology and Nuclear Medicine

2. Physics and Engineering in Medicine

1. Independently perform or participate in acceptance tests/commissioning/calibration for each of the five large modalities (SPECT/PET/Fluoroscopy/MRI/CT).
2. Perform protocol optimization on a radiological or nuclear imaging modality.
3. Guide the introduction of a software application in the field of RNM (such as AI tool for reconstruction, images analysis project).
4. Deliver education to medical disciplines on image techniques.
5. Advise in the building/room design requirements, determine electrical safety requirements and perform acceptance tests for medical rooms, specifically concerning Ionising and Electromagnetic radiation protection.

3. Risk Management, Quality Control and Safety in the Medical Environment

1. Evaluate a radiological or nuclear imaging QC policy and give advice on addition/removal of QC tests.
2. Perform a risk analysis for the introduction of an image guided intervention.
3. Handle individual cases of patients with implants who are referred for an MRI scan.

4. Radiation Physics, (Radiation) Protection and Dosimetry

1. Perform dosimetry calculations for radionuclide therapy,
2. Perform dosimetry calculations for radiological and radionuclide imaging,
3. Independently fill a QC phantom with radionuclides and perform the decontamination procedures after a spill of liquid radionuclide.

5. IT and data science

1. Perform an ICT project in the area of RNM (e.g. PACS, Portals, VNA, transmural image exchange).

6. Organisation, management, finance, laws and ethics in healthcare

1. Participate in the investment advisory process of the department or institute
2. Participate in the procurement process (including procurement, installation, testing and implementation) of a new medical device or medical software as part of a multidisciplinary team.

V.1.e. Radiotherapy

1. The patient: Fundamentals of Human Anatomy, Physiology, Psychophysics, Pathology, and Interacting with Patient

1. Follow the treatment chain for curative treatment for one individual patient from multidisciplinary tumour board to first treatment fraction including patient consultation.

2. Physics and Engineering in Medicine

i. Treatment equipment for external radiotherapy

1. Perform acceptance testing and commissioning of a treatment unit, treatment planning system or imaging modality (MRI, CT) that is used for radiotherapy simulation.

2. Physics and Engineering in Medicine

ii. Treatment simulation and planning

1. Participate in the multidisciplinary development of a new treatment planning technique, focusing on clinical constraints, treatment efficiency and safety as well as dosimetric quality.
2. Analyse plans for plan quality and potential pitfalls in delivery.
3. Perform a treatment plan comparison for proton therapy.

2. Physics and Engineering in Medicine

iii. External beam treatment delivery, verification and modification

1. Advise on used PTV margins or robust treatment planning procedure for a radiotherapy treatment based on literature, measurements and calculations.

2. Physics and Engineering in Medicine

iv. Brachytherapy

1. Be present during the preparation and treatment of one patient treated with 3D image-guided brachytherapy (e.g., prostate, cervix), including presence at the operating room.

2. Be present at a source replacement by the company, perform a measurement of the source activity and import this activity in the TPS.

4. Radiation Physics, (Radiation) Protection and Dosimetry

1. Participate in an external dosimetry audit.

6. Organisation, management, finance, laws and ethics in healthcare

1. Participate in the investment advisory process of the department or institute
2. Participate in the procurement process (including procurement, installation, testing and implementation) of a new medical device or medical software as part of a multidisciplinary team.

V.2. EPAs (Audiology, in Dutch)

Beschrijving keuze en verantwoording leerdoelen

Van de huidige beroepsbeoefenaar wordt verwacht dat zij niet alleen vakbekwaam is, maar ook dat zij op haar handelen kan reflecteren en haar handelen kan verantwoorden. Ook moet zij in onvoorziene omstandigheden adequaat kunnen handelen en zij moet er op gericht zijn haar handelen continue te verbeteren. De beroepsbeoefenaar moet dus niet alleen vakbekwaam kunnen handelen, maar ook beroepsbekwaam zijn. Dit betekent dat kennis, vaardigheden en beroepshouding een integraal en samenhangend onderdeel zijn van beroepsmatig handelen.
Om hier passend en aansluitend bij en nascholing bij aan te bieden bij deze (beroeps)bekwaamheden moeten deze vertaald worden naar leerdoelen.

Een leerdoel beschrijft een streefsituatie met betrekking tot het verwerven van kennis en vaardigheden.

Leerdoelen zijn belangrijk omdat leerdoelen sturing geven aan het leerproces. Daarbij voorzien leerdoelen als basis voor de inhoudelijke invulling van een leermiddel.

Om op een juiste manier de beroepsbekwaamheden te vertalen naar leerdoelen maakt Noordhoff Health gebruik van twee taxonomische instrumenten die complementair aan elkaar zijn; de prestatiematrix en de Taxonomie van Bloom.

Dit onderdeel gaat in op de deze twee verschillende taxonomieën en vertaalt dit naar een concreet voorbeeld.

Prestatiematrix beroepsbekwaam handelen

De prestatiematrix beroepsbekwaam handelen is een instrument om beroepskwalificaties te specificeren in leerdoelen of beroepseisen.

De prestatiematrix is samengesteld vanuit de gedachte dat beroepsbekwaam handelen integraal handelen is (hoofd, handen en hart). Iedere beroepsbekwaamheid wordt als zodanig geanalyseerd en beschreven in onderliggende leerdoelen, waarbij ook de beroepshouding deel uitmaakt van de leerdoelen.

De prestatiematrix is opgebouwd uit de drie handelingscategorieën in combinatie met drie bekwaamheidsniveaus.

Handelingscategorieën

Over het algemeen worden er drie soorten leerdoelen onderscheiden; leerdoelen waarin beschreven staat wat iemand moet weten, leerdoelen waarin staat wat iemand moet kunnen en leerdoelen waarin staat hoe iemand zich moet gedragen. Vanuit het principe dat de beroepsbeoefenaar niet alleen vakbekwaam moet kunnen handelen, maar ook beroepsbekwaam moet zijn, worden deze drie soorten leerdoelen in de prestatiematrix vertaald naar de volgende handelingscategorieën:

- Cognitief – reflectief handelen
- Vakmatig – methodisch handelen
- Sociaal – communicatief handelen

Bekwaamheidsniveaus

De prestatiematrix ordent daarnaast leerdoelen naar drie bekwaamheidsniveaus:

- reproductief handelen
- productief handelen
- zelfsturend handelen

Hierbij wordt dus uitgegaan van een toenemende mate van zelfstandig en verantwoordelijk handelen naar zelfsturend handelen als eindniveau.

Op de kruising van cellen ontstaan negen algemene handelingsbekwaamheden die vertaald kunnen worden in leerdoelen.

		Handelingscategorieën		
		Cognitief – reflectief *Weten, denken*	**Vakmatig – methodisch** *Systematisch handelen*	**Sociaal – communicatief** *Communiceren*
	Reproductief handelen	Wat moet ik weten, begrijpen?	Wat moet ik kunnen?	Hoe moet ik me gedragen?
	Productief handelen	Wat moet ik kunnen bedenken, beredeneren?	Wat moet ik volgens plan kunnen uitvoeren?	Hoe moet ik samenwerken of omgaan met anderen?
	Zelfsturend handelen	Wat moet ik kunnen doen om te verbeteren?	Wat moet ik kunnen uitvoeren in de praktijk?	Hoe moet ik me kunnen verantwoorden?

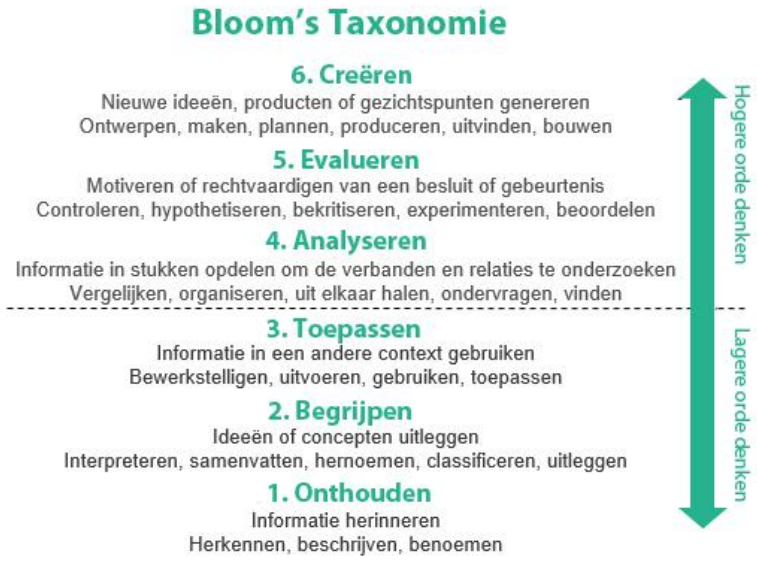
Taxonomie van Bloom

De prestatiematrix laat de formulering van de leerdoelen vrij. Noordhoff Health gebruikt voor de formulering van leerdoelen en de hieraan gerelateerde acties en producten de Taxonomie van Bloom.

In de Taxonomie van Bloom worden zes niveaus onderscheiden:

1. onthouden
2. begrijpen
3. toepassen
4. analyseren
5. evalueren
6. creëren

Met de niveaus wordt onderscheid gemaakt in de complexiteit van het kennisniveau waarop een beroep wordt gedaan. De eerste drie niveaus behoren tot de ‘lagere orde vragen’, de laatste drie tot de ‘hogere orde vragen’. In een rijke leeractiviteit worden meerdere niveaus aangesproken.



Afbeelding B2.1. Taxonomie van Bloom

De niveaus van Bloom zijn te vertalen naar de bekwaamheidsniveaus van de prestatiematrix, waardoor deze twee taxonomieën als het ware in elkaar schuiven.

Prestatiematrix		Handelingscategorieën		
Bekwaamheidsniveaus		Cognitief – reflectief *Weten, denken*	Vakmatig – methodisch *Systematisch handelen*	Sociaal – communicatief *Communiceren*
Onthouden Begrijpen	Reproductief handelen	Wat moet ik weten, begrijpen?	Wat moet ik kunnen?	Hoe moet ik me gedragen?
Toepassen Analyseren	Productief handelen	Wat moet ik kunnen bedenken, beredeneren?	Wat moet ik volgens plan kunnen uitvoeren?	Hoe moet ik samenwerken of omgaan met anderen?
Evalueren Creëren	Zelfsturend handelen	Wat moet ik kunnen doen om te verbeteren?	Wat moet ik kunnen uitvoeren in de praktijk?	Hoe moet ik me kunnen verantwoorden?

In de Taxonomie van Bloom worden actiewoorden gebruikt bij de formulering van de leerdoelen. Hiermee wordt meteen duidelijk gemaakt op welk niveau het leerdoel zich bevindt. Voorbeelden van actiewoorden zijn: benoem, definieer, vat samen, leg verbanden, pas toe, onderzoek, analyseer, orden en ontwikkel. Voor een overzicht van welke vaardigheden, type leerdoelen en voorbeelden van formuleringen met actie horen bij ieder niveau, zie afbeelding B2.1 ‘De zes niveaus van Bloom’.

Een voorbeeld

Het invullen van de cellen uit de prestatiematrix volgens de formulering van Bloom gebeurt op basis van een hoofdleerdoel wat voor het betreffende leerpad is geformuleerd.

Het invullen van de cellen leidt tot subleerdoelen die bijdragen aan het behalen van het hoofdleerdoel.

Voor een student uit het initieel onderwijs is een leerdoel bijvoorbeeld:

Je kunt de zorgvrager op basis van het zorg(leef)plan bij de persoonlijke verzorging ondersteunen.

Dit leerdoel kan op de volgende manier vertaalde worden naar subleerdoelen in de combinatie van de prestatiematrix met de niveaus en formulering van Bloom:

Prestatiematrix		Handelingscategorieën		
Bekwaamheidsniveaus		Cognitief – reflectief *Weten, denken*	Vakmatig – methodisch *Systematisch handelen*	Sociaal – communicatief *Communiceren*
Onthouden Begrijpen	Reproductief handelen	Je kunt de bouw en functie van de huid benoemen.	Je kunt de vijf aandachtspunten voor het ondersteunen van een zorgvrager bij de persoonlijke verzorging beschrijven.	Je kunt respect tonen voor de eigenheid en privacy van de zorgvrager en naastbetrokkenen.
Toepassen Analyseren	Productief handelen		Je kunt een zorgvrager ondersteunen bij uit- en aankleden met behulp van de vier uit- en aankleedtechnieken. Je kunt een zorgvrager ondersteunen bij wassen of baden.	Je kunt bij de persoonlijke verzorging actief rekening houden met mogelijkheden, wensen en gewoonten van de zorgvrager en naastbetrokkenen. Je kunt de zorgvrager en naastbetrokkenen op een overtuigende manier motiveren tot haalbare activiteiten.
Evalueren Creëren	Zelfsturend handelen		Je kunt observaties uit het zorgplan verrichten tijdens de persoonlijke verzorging.	

Hoofddoel: Je kunt als KF Audioloog voor een volwassen zorgvrager de aard en ernst van een gehoorverlies vaststellen en deze relateren aan de klachten.

Prestatiematrix EPA 1: Diagnostiek volwassenen **Supervisie eindniveau: 5**			**Handelingscategorieën**		
Bekwaamheidsniveaus			**Cognitief – reflectief** *Weten, denken*	**Vakmatig – methodisch** *Systematisch handelen*	**Sociaal – communicatief** *Communiceren*
Onthouden Begrijpen *Beschrijf, herken, benoem, interpreer, vat samen, leg uit, classificeer, hernoem*		**Reproductief Handelen**	Wat moet ik weten, begrijpen? - (Patho)fysiologie van het gehoororgaan - Psychofysica van toon- en spraakaudiometrie - Biofysica van het gehoor - Theorie van toon- en spraakaudiometrie, met en zonder ruis. - Theorie van impedantiemetrie (tympanometrie en reflexmetingen) - Achtergronden tinnitus en hyperacusis/geluidgevoeligheid.	Wat moet ik kunnen? - Weten welke protocollen er zijn voor volwassenendiagnostiek - Weten welke onderzoekscodes bij welk onderzoek horen - Weten wat de werkprocedures zijn bij audiometrie	Hoe moet ik me gedragen? - Belang begrijpen van nauwkeurig werken - Duidelijk kunnen spreken, zo nodig aangepast aan de luisteraar (aangepast tempo, mondbeeld zichtbaar) - Weten welke vragen gesteld moeten worden om de klacht in beeld te brengen (oa relevante medische anamnese, audiologische anamnese)
Toepassen Analyseren *Bewerkstellig, voer uit, gebruik, pas toe, vergelijk, organiseer, haal uit elkaar, ondervraag, vind*		**Productief handelen**	Wat moet ik kunnen bedenken, beredeneren? - Indicatie voor toon- en spraakaudiometrie (in ruis). - Indicatie voor maskeren bij toon- en spraakaudiometrie - Indicatie impedantiemetrie - Of een spraakaudiogram passend is bij een toonaudiogram (voor de gevonden perceptieve, conductieve of mogelijk retrocochleare problematiek)	Wat moet ik volgens plan kunnen uitvoeren? - Het maken van een volledig gemaskeerd toon- en spraakaudiogram volgens protocol (niveau 'toepassen') - Zelfstandig kunnen vaststellen wanneer gemaskeerd moet worden bij toon- en spraakaudiometrie (niveau 'analyseren') - Het verrichten van impedantiemetrie, en controleren van de betrouwbaarheid. - Het volgen van het tinnitus-suisanalyse-protocol - Noteren van relevante bevindingen tijdens diagnostiek (zoals klachten	Hoe moet ik samenwerken of omgaan met anderen? - Instructies afstemmen op niveau van de patiënt - Patiënt motiveren om zijn best te doen bij de audiometrie - Feedback van collega's kunnen ontvangen en omzetten naar verbeteringen.

				zorgvrager of vermoeden van aggravatie) - Duidelijke uitleg kunnen verschaffen over een audiogram aan zowel professionals als patiënten.	
Evalueren **Creëren** *Controleer, hypothetiseer, bekritiseer, experimenteer, beoordeel, ontwerp, maak, plan, produceer, vind uit, bouw*		**Zelfsturend handelen**	Wat moet ik kunnen doen om te verbeteren? - *In staat zijn om het eigen handelen kritisch te bezien* - *Herkennen van kwaliteit issues* - *Herkennen van kennis lacunes* - *Literatuuronderzoek kunnen uitvoeren* - *Op basis van theoretische kennis tot een oplossing komen voor de kennis- en kwaliteitslacunes.*	Wat moet ik kunnen uitvoeren in de praktijk? - Op basis van zorgvraag kunnen bepalen welke metingen nodig zijn en tijdens een meting eventueel de onderzoeken aanvullen voor een goede diagnostiek, zo nodig buiten de standaard zorgprotocollen om. - Controleren/interpreteren van toon- en spraakaudiometrie, zowel zelf uitgevoerde als van collega's - Interpreteren van tympanometrie - Evalueren van de betrouwbaarheid van een suisanalyse.	Hoe moet ik me kunnen verantwoorden? - *Juiste vragen kunnen stellen om zorgvraag helder te krijgen* - *Helder ideeën kunnen verwoorden* - *Collega's kunnen motiveren* - *Feedback aan collega's kunnen geven zodanig dat er een veilige leeromgeving is* - *Verantwoordelijkheid kunnen nemen voor de borging van de kwaliteit binnen het AC.*

NB: de schuingedrukte onderwerpen komen nog terug in latere EPA beschrijvingen, en vallen buiten het supervisie eindniveau van dit betreffende EPA.

Hoofddoel: Je hebt als KF Audioloog inzicht in het gehele zorgtraject van een volwassene met licht tot zeer ernstig gehoorverlies en kunt deze zorg als behandelaar binnen het multidisciplinair team zelfstandig uitvoeren.

Prestatiematrix EPA 2: Hoorrevalidatie volwassenen Supervisie eindniveau: 5 **Bekwaamheidsniveaus**			**Handelingscategorieën**		
			Cognitief – reflectief *Weten, denken*	**Vakmatig – methodisch** *Systematisch handelen*	**Sociaal – communicatief** *Communiceren*
Onthouden Begrijpen *Beschrijf, herken, benoem, interpreer, vat samen, leg uit, classificeer, hernoem*		**Reproductief Handelen**	Wat moet ik weten, begrijpen? - Basiskennis over de oorzaken van slechthorendheid en behandelmethoden - Kennis van meest voorkomende klachten bij gehoorverlies - Kennis van psychosociale aspecten rondom slechthorendheid - Weten hoe het hoorrevalidatieproces verloopt. - Kennis over verzekeringsmogelijkheden. - Kennis over hoortoestellen: verschillende typen, onderdelen en werking van – en signaalbewerking door hoortoestellen - Kennis over onderdelen en werking van BCD's - Kennis van oorstukjes: typen en materialen - Kennis over aanvullende hulpmiddelen: solo-apparatuur, remote mic, TV-oplossing, wek- en waarschuwingssysteem	Wat moet ik kunnen? - Anamnese afnemen - Resultaten audiometrie bespreken en relateren aan klachten van de patiënt - Bespreken van behandeldoelen - Uitleg geven over het gehoor(verlies) en bijkomende klachten - Uitleg over het revalidatieproces, eigenschappen van hoortoestellen en hulpmiddelen, en aspecten t.a.v. de zorgverzekering - Real Ear Meting (REM) uitvoeren - Uitvoeren aanpassing en bijstelling van hoortoestel(len) - Recept opstellen voor hoortoestel(len) en overige hulpmiddelen - Administratie van het consult, waaronder het noteren van aantekeningen in het dossier en het uitvoeren van verrichtingen. - Participeren in MDO	Hoe moet ik me gedragen? - Gespreksvaardigheden gebruiken zoals luisteren, samenvatten en doorvragen (LSD), om informatie te verzamelen over het leven met gehoorverlies specifiek voor de patiënt. - Het functioneren van de patiënt breed uitvragen en bespreken met als leidraad het ICF-model (International Classification of Functioning). - Omgaan met slechthorende patiënten, te weten goed articuleren, niet te snel praten, en patiënten goed aankijken tijdens het gesprek - Goed omgaan met dynamiek tussen patiënt en partner / familie / begeleiders. - Basisvaardigheden counseling toepassen, waaronder afstemming van informatie/communicatie aan behoeften van patiënt, inclusief ' shared desicion making'.

			- Kennis over rekenregels: DSL, NAL-NL1, NAL-NL2. - Kennis over verificatie- en validatiemethoden (waaronder Real Ear metingen, spraaktesten met hoortoestellen, gebruik vragenlijsten) - Kennis over niet-technische onderdelen van revalidatie: psychosociale zorg, acceptatie, mentale ondersteuning, hoor- en luisterstrategieën, communicatie-ondersteuning en spraakafzien e.d.		
Toepassen Analyseren *Bewerkstellig, voer uit, gebruik, pas toe, vergelijk, organiseer, haal uit elkaar, ondervraag, vind*		**Productief handelen**	Wat moet ik kunnen bedenken, beredeneren? - In het verhaal van de patiënt benoemde en onbenoemde functioneringsproblemen herkennen die behandeling nodig hebben. - Beoordeel of de audiologische onderzoeken onderling een consistent beeld geven en passen bij de klachten - Opstellen van een (audiologische) diagnose op basis van de voorgeschiedenis, klachten en de onderzoeken - Vervolgbeleid bepalen o.b.v. audiologische en medische diagnose, rekening houdend met de wensen en behoeften van de patiënt, met aandacht voor de psychosociale kant. - Indicatie voor BCD kunnen stellen o.b.v. beengeleidingsdrempels en otologische factoren	Wat moet ik volgens plan kunnen uitvoeren? - Optimalisatie van de hoortoestelinstellingen bij verschillende types en mate van gehoorverlies op basis van beschikbare informatie (gehoorverlies, REM, spraakverstaan, ervaringen patiënt) - Uitvoeren van metingen om bepaalde klachten of defecten van het hoortoestel te kunnen adresseren. - BCD aanpassing en controle, waaronder metingen met de skull-simulator - Bespreken van revalidatiemogelijkheden, inclusief CI als vervolgbeleid en doorverwijzing naar het CI-team. - Doorverwijzing naar maatschappelijk werk, psycholoog, KNO-arts - Correspondentie naar verwijzers verzorgen	Hoe moet ik samenwerken of omgaan met anderen? - Bespreken van psychosociale aspecten rondom slechthorendheid met patiënt - Inleven in het effect van beperkingen - Belemmerende gedachten bij patiënten bespreekbaar kunnen maken - Patiënten kunnen motiveren waar nodig - Verwachtingsmanagement - Feedback van collega's kunnen vragen en ontvangen - Beleid afstemmen met maatschappelijk werker/psycholoog en/of KNO-arts

			- Audiologische indicatie voor CI kunnen stellen o.b.v. het auditief functioneren en (verloop) van het gehoorverlies - Weten wanneer de REM afwijkend is en waar dat aan zou kunnen liggen - Klachten van de patiënt relateren aan de resultaten van de REM en de instellingen van de hoortoestel(len) - Evaluatiemetingen met hoortoestel(len) beoordelen (met name spraakverstaan) en relateren aan REM, vragenlijsten en ervaringen patiënt.	- Contact met audiciens en andere behandelaren van de patiënt - Eigen casussen inbrengen in het MDO	
Evalueren **Creëren** *Controleer, hypothetiseer, bekritiseer, experimenteer, beoordeel, ontwerp, maak, plan, produceer, vind uit, bouw*		**Zelfsturend handelen**	Wat moet ik kunnen doen om te verbeteren? - *In staat zijn om het eigen handelen kritisch te bezien* - *Herkennen van kwaliteit issues* - *Herkennen van kennis lacunes* - *Literatuuronderzoek kunnen uitvoeren* - *Op basis van theoretische kennis tot een oplossing komen voor de kennis- en kwaliteitslacunes.*	Wat moet ik kunnen uitvoeren in de praktijk? - kunnen bepalen welke metingen nodig zijn en tijdens een meting eventueel de onderzoeken aanvullen voor een goede diagnostiek - Controleren/interpreteren van meetgegevens en verslaglegging, zowel zelf uitgevoerde als van collega's	Hoe moet ik me kunnen verantwoorden? - *Juiste vragen kunnen stellen om zorgvraag helder te krijgen* - *Helder ideeën kunnen verwoorden* - *Collega's kunnen motiveren* - *Feedback aan collega's kunnen geven zodanig dat er een veilige leeromgeving is* - *Verantwoordelijkheid kunnen nemen voor de borging van de kwaliteit binnen het AC.*

NB: de schuingedrukte onderwerpen komen nog terug in latere EPA beschrijvingen, en vallen buiten het supervisie eindniveau van dit betreffende EPA.

Hoofddoel: Je kunt als KF Audioloog voor een kind de aard en ernst van een gehoorverlies vaststellen en deze relateren aan de klachten en aan het talig en algemeen functioneren.

Prestatiematrix EPA 3: gehoordiagnostiek kinderen **Supervisie eindniveau : 4** **Bekwaamheidsniveaus**			**Handelingscategorieën** **Cognitief – reflectief** *Weten, denken*	**Vakmatig – methodisch** *Systematisch handelen*	**Sociaal – communicatief** *Communiceren*
Onthouden Begrijpen *Beschrijf, herken, benoem, interpreteer, vat samen, leg uit, classificeer, hernoem*		**Reproductief Handelen**	Wat moet ik weten, begrijpen? - De ontwikkeling van het gehoororgaan en auditieve waarneming ook in relatie tot ziekten en syndromen - Theorie van gedragsaudiometrie (observatie, VRA, spelaudiometrie, toon/spraak, onderzoek van spraakverstaan in ruis) - Theorie van elektrofysiologische diagnostiek (BERA/ASSR, OAE) - Theorie van impedantiemetrie - Kennis van risicofactoren op gehoorverlies (infecties, syndromen etc) - Auditieve ontwikkeling kind normaal/afwijkend - Achtergronden spraak- en taalontwikkeling kind: normaal/afwijkend	Wat moet ik kunnen? - Weten welke protocollen er zijn voor audiologische diagnostiek bij kinderen: gedragsaudiometrie, elektrofysiologische diagnostiek, impedantiemetrie. - Weten wat de werkprocedures zijn bij kinderaudiometrie - Weten welke onderzoekscodes / zorgactiviteiten bij welk onderzoek horen	Hoe moet ik me gedragen? - Belang van nauwkeurig en systematisch werken - Belang van afstemming op ouders die zorg hebben om hun kind - Belang van afgestemde omgang met neonaten en jonge kinderen - Weten welke vragen gesteld moeten worden om de klacht in beeld te brengen (oa relevante medische anamnese, audiologische anamnese)
Toepassen Analyseren *Bewerkstellig, voer uit, gebruik, pas toe, vergelijk, organiseer, haal uit elkaar, ondervraag, vind*		**Productief handelen**	Wat moet ik kunnen bedenken, beredeneren? - Indicaties voor vormen van gedragsaudiometrie - Indicaties voor doorverwijzing naar KNO bij middenoorproblemen.	Wat moet ik volgens plan kunnen uitvoeren? - Gedragsaudiometrisch onderzoek - Elektrofysiologisch onderzoek - Impedantie-audiometrisch onderzoek - Systematische anamnese van auditief, talig en algemeen functioneren	Hoe moet ik samenwerken of omgaan met anderen? - Communicatie in spreekkamer afstemmen op niveau en acceptatiefase ouders - Samenwerken met collega's bij gedragsaudiometrie en elektrofysiologische diagnostiek

			- Samenhang tussen observaties van auditief functioneren en metingen op AC - Samenhang tussen resultaten audiologische diagnostiek en taalontwikkeling en algemene ontwikkeling		- Vanuit eigen discipline en overstijgend bevindingen bespreken met collega's binnen en buiten AC
Evalueren **Creëren** *Controleer, hypothetiseer, bekritiseer, experimenteer, beoordeel, ontwerp, maak, plan, produceer, vind uit, bouw*		**Zelfsturend handelen**	Wat moet ik kunnen doen om te verbeteren? - *In staat zijn om het eigen handelen kritisch te bezien* - *Herkennen van kwaliteit issues* - *Herkennen van kennis lacunes* - *Literatuuronderzoek kunnen uitvoeren* - *Op basis van theoretische kennis tot een oplossing komen voor de kennis- en kwaliteitslacunes.*	Wat moet ik kunnen uitvoeren in de praktijk? - Op basis van zorgvraag kunnen bepalen welke metingen nodig zijn en tijdens een meting eventueel de onderzoeken aanvullen voor een goede diagnostiek - Controleren/interpreteren van gedragsaudiometrie en elektrofysiologische diagnostiek en impedantiemetrie; zowel zelf uitgevoerd als van collega's - In multidisciplinair overleg anamnestische en diagnostische resultaten in kader kunnen plaatsen en gezamenlijk tot integrale conclusie komen - Met ouders gesprek kunnen voeren over beleid obv audiologische en multidisciplinaire diagnostiek	Hoe moet ik me kunnen verantwoorden? - *Juiste vragen kunnen stellen om zorgvraag helder te krijgen* - *Helder ideeën kunnen verwoorden* - *Collega's kunnen motiveren* - *Feedback aan collega's kunnen geven zodanig dat er een veilige leeromgeving is* - *Verantwoordelijkheid kunnen nemen voor de borging van de kwaliteit binnen het AC.*

NB: de schuingedrukte onderwerpen komen nog terug in latere EPA beschrijvingen, en vallen buiten het supervisie eindniveau van dit betreffende EPA.

Hoofddoel: Je kunt als KF Audioloog een kind met gehoorverlies behandelen als lid van een multidisciplinair team met oog op auditief, talig en algemeen functioneren.

Prestatiematrix EPA 4: gehoorrevalidatie kinderen **Supervisie eindniveau : 4** **Bekwaamheidsniveaus**			**Handelingscategorieën** **Cognitief – reflectief** *Weten, denken*	**Vakmatig – methodisch** *Systematisch handelen*	**Sociaal – communicatief** *Communiceren*
Onthouden Begrijpen *Beschrijf, herken, benoem, interpreer, vat samen, leg uit, classificeer, hernoem*		**Reproductief Handelen**	Wat moet ik weten, begrijpen? - De theorie van technische hoorhulpmiddelen de aanpassing daarvan: hoortoestellen, BCDs, CI, overige hulpmiddelen - Theorie van gedragsaudiometrie in de evaluatie van audiologische behandeling (observatie, VRA, spelaudiometrie, toon/spraak, onderzoek van spraakverstaan in ruis) - Theorie van verificatiemetingen in de evaluatie van audiologische behandeling (observatie, VRA, spelaudiometrie, toon/spraak, onderzoek van spraakverstaan in ruis, Real Ear Measurements, RECD)	Wat moet ik kunnen? - Weten welke protocollen er zijn voor audiologische revalidatie bij kinderen: technische hoortoestelrevalidatie en -verificatie, functionele evaluatie, - Weten wat de zorgpaden zijn voor revalidatie van gehoor kinderen - Weten welke onderzoekscodes/ zorgactiviteiten bij welk onderzoek horen	Hoe moet ik me gedragen? - Belang van nauwkeurig en systematisch werken - Belang van afstemming op ouders die zorg hebben om hun kind - Belang van afgestemde omgang met neonaten en jonge kinderen - Weten welke vragen gesteld moeten worden om het effect van behandeling in beeld te brengen (evaluatie auditief functioneren)
Toepassen Analyseren *Bewerkstellig, voer uit, gebruik, pas toe, vergelijk, organiseer, haal uit elkaar, ondervraag, vind*		**Productief handelen**	Wat moet ik kunnen bedenken, beredeneren? - Indicaties voor hoorrevalidatie: tijdpad (mijlpalen) keuze soort en type hulpmiddel - Samenhang tussen observaties van auditief functioneren met hulpmiddelen in het dagelijks leven en metingen op AC - Samenhang tussen resultaten audiologische voortgangsdiagnostiek	Wat moet ik volgens plan kunnen uitvoeren? - Aanpassen hoortoestellen, BCDs o.b.v. electrofysiologische gegevens en/of audiometrische gegevens - Controleren van de technische hoorrevalidatie dmv systematische anamnese, gedragsaudiometrie en verificatie-metingen.	Hoe moet ik samenwerken of omgaan met anderen? - Communicatie in spreekkamer afstemmen op niveau en acceptatiefase ouders - Samenwerken met collega's bij gedragsaudiometrie - Vanuit eigen discipline en overstijgend bevindingen bespreken met collega's binnen en buiten AC

			en taalontwikkeling en algemene ontwikkeling		
Evalueren **Creëren** *Controleer, hypothetiseer, bekritiseer, experimenteer, beoordeel, ontwerp, maak, plan, produceer, vind uit, bouw*		**Zelfsturend handelen**	Wat moet ik kunnen doen om te verbeteren? - *In staat zijn om het eigen handelen kritisch te bezien* - *Herkennen van kwaliteitsissues* - *Herkennen van eigen kennislacunes* en in het team - *Literatuuronderzoek kunnen uitvoeren*, ook discipline-overstijgend - *Op basis van theoretische kennis tot een oplossing komen voor de kennis- en kwaliteitslacunes.*	Wat moet ik kunnen uitvoeren in de praktijk? - Op basis van anamnese kunnen bepalen welke metingen nodig zijn en tijdens een meting eventueel de onderzoeken aanvullen voor een goede voortgangsdiagnostiek - Controleren/interpreteren van gedragsaudiometrie en verificatiemetingen zowel zelf uitgevoerd als van collega's - In multidisciplinair overleg anamnestische en diagnostische resultaten in kader kunnen plaatsen en gezamenlijk tot integrale conclusie komen - Met ouders gesprek kunnen voeren over beleid obv audiologische en multidisciplinaire diagnostiek	Hoe moet ik me kunnen verantwoorden? - *Juiste vragen kunnen stellen om zorgvraag helder te krijgen* - *Helder ideeën kunnen verwoorden* - *Collega's kunnen motiveren* - *Feedback aan collega's kunnen geven zodanig dat er een veilige leeromgeving is* - *Verantwoordelijkheid kunnen nemen voor de borging van de kwaliteit binnen het AC.*

Hoofddoel: Je hebt als KF Audioloog inzicht in het gehele zorgtraject van een volwassene met (of kandidaat voor) een CI en kunt deze zorg als behandelaar binnen het CI-team zelfstandig uitvoeren

Prestatiematrix EPA 5: CI volwassenen **Supervisie eindniveau: 4** **Bekwaamheidsniveaus**			**Handelingscategorieën** **Cognitief – reflectief** *Weten, denken*	**Vakmatig – methodisch** *Systematisch handelen*	**Sociaal – communicatief** *Communiceren*
Onthouden Begrijpen *Beschrijf, herken, benoem, interpreteer, vat samen, leg uit, classificeer, hernoem*		**Reproductief Handelen**	Wat moet ik weten, begrijpen? - Doofheid / ernstige slechthorendheid: oorzaken, aanvang en gevolgen voor het auditief systeem en het individu, aanvullend aan de kennis zoals opgedaan bij EPA revalidatie volwassenen - bouw en werking van het implantaat - Volumegeleiding in en rondom de cochlea - neurale prikkeling auditieve systeem - Effecten pulsbreedte, pulsduur, pulsfrequentie - Effecten van spectrale en temporele sommatie - Stimulatiestrategieën (CIS en varianten) - Pre-processing (ruisonderdrukking, dynamiekcompressie, ...) - Kennis van verschillende CI-merken (implantaten, processoren, connectiviteit) - Kennis van bimodale aanpassingen - Kennis van elektro-akoestische stimulatie (EAS) - Objectieve metingen - Regelgeving hulpmiddelen - Regelgeving rondom CI (veldnorm, 5-18 jarigen, etc.)	Wat moet ik kunnen? - Fitten van de CI - Resultaatmetingen met de CI verrichten en interpreteren - Bijwonen multidisciplinaire bespreking CI, inclusief inbrengen casus	Hoe moet ik me gedragen? - Kennis van beperkingen als gevolg van slechthorendheid: auditief, auditief-visueel, talig, emotioneel - Omgaan met dove patiënten, begrip voor gebruik gebaren, zich kunnen verplaatsen in hun perspectief/achtergrond - Counseling kandidaten en partner vanuit hun behoefte en op hun niveau, stimuleren/motiveren o.a. in actieve revalidatiefase

			- Structuur landelijk overleg (CION) - Verloop intakegesprekken CI-kandidaat bij de diverse disciplines		
Toepassen Analyseren *Bewerkstellig, voer uit, gebruik, pas toe, vergelijk, organiseer, haal uit elkaar, ondervraag, vind*		**Productief handelen**	Wat moet ik kunnen bedenken, beredeneren? - Weten wanneer CI onveilig kan zijn (infecties, intolerantie materialen, MRI-compatibiliteit) en hoe te handelen. - Te verwachten resultaat CI gegeven voorgeschiedenis (bijv. prelinguale doofheid) en actie ondernemen als resultaat minder dan verwacht - Herkennen complicaties die collegiaal overleg behoeven - Indicatiestelling CI, op welk moment doorverwijzen naar CI-team, bepalende factoren - Indicatiestelling CI, bij naar CI-team verwezen patiënten	Wat moet ik volgens plan kunnen uitvoeren? - Bepalen of een kandidaat audiologisch geïndiceerd is voor CI - Informeren van CI-kandidaten wat wél en wat niet te verwachten van CI. - Het beoordelen van technische integriteit CI (extern materiaal, impedanties) - Het bepalen van stimulatieniveaus onder- en bovengrens. - Kiezen tussen alternatieve wijzen van fitten (balanceren vs luidheidsschaling, per electrode vs luidheid vv stimuli) - Het opsporen van afwijkende electroden (impedantie, toonhoogte, niet-auditieve sensatie) en hierop handelen. - Het opsporen van neveneffecten (pijn, huidproblemen onder coil, etc.) - Complexe casussen analyseren en behandelplan opstellen - Solo/draadloze accessoires aansluiten - Troubleshooting - Noteren van relevante bevindingen tijdens consult (zoals klachten zorgvrager of vermoeden van aggravatie)	Hoe moet ik samenwerken of omgaan met anderen? - Inleven in effect beperkingen doofheid - Rustig communiceren met doven met een duidelijk mondbeeld - Zo nodig eenvoudig taalniveau gebruiken - Zo nodig inzetten van tolk (NGT, NmG, schrijf) - Instructies afstemmen op niveau van de patiënt - Aanpassen wijze van fitten aan individuele patiënt - Patiënt motiveren bij detectie- en identificatietaken - Patiënt motiveren tijdens het revalidatieproces (uitleg wat wél en wat niet te verwachten van CI). - Feedback van collega's kunnen ontvangen - Kort en duidelijk rapporteren aan teamleden
Evalueren Creëren *Controleer, hypothetiseer, bekritiseer, experimenteer, beoordeel,*		**Zelfsturend handelen**	Wat moet ik kunnen doen om te verbeteren? - *Herkennen van kennislacunes* - *Literatuuronderzoek kunnen uitvoeren*	Wat moet ik kunnen uitvoeren in de praktijk? - Op basis van zorgvraag kunnen bepalen welke metingen nodig zijn en tijdens een meting eventueel de onderzoeken aanvullen voor een goede diagnostiek	Hoe moet ik me kunnen verantwoorden? - *Juiste vragen kunnen stellen om zorgvraag helder te krijgen* - *Helder ideeën kunnen verwoorden* - *Collega's kunnen motiveren*

ontwerp, maak, plan, produceer, vind uit, bouw			- *Op basis van theoretische kennis tot een oplossing komen voor de kennis- en kwaliteitslacunes.*	- Controleren/interpreteren van meetgegevens en verslaglegging, zowel zelf uitgevoerde als van collega's	- *Feedback aan collega's kunnen geven zodanig dat er een veilige leeromgeving is*

Hoofddoel: Je hebt als KF Audioloog inzicht in het gehele zorgtraject van een kind met een CI en kunt delen van deze zorg als behandelaar binnen het CI-team zelfstandig uitvoeren

Prestatiematrix EPA 6: CI kinderen **Supervisie eindniveau :** **3 voor oudere kinderen** **1 voor babies/jonge kinderen**			**Handelingscategorieën**		
			Cognitief – reflectief *Weten, denken*	**Vakmatig – methodisch** *Systematisch handelen*	**Sociaal – communicatief** *Communiceren*
Bekwaamheidsniveaus					
Onthouden Begrijpen *Beschrijf, herken, benoem, interpreer, vat samen, leg uit, classificeer, hernoem*		**Reproductief Handelen**	Wat moet ik weten, begrijpen?* - neurale prikkeling auditieve systeem: kritische perioden deprivatie, afwijkingen bij aanleg- of neuronale stoornis/auditieve neuropathie - Objectieve metingen bij kinderen: impedanties, NRT (relatie met C/M-levels), principes e-BERA en P300	Wat moet ik kunnen? - Anamnese - Fitten van oudere kinderen - Resultaatmetingen verrichten en interpreteren - Inbreng casus multidicisplinaire bespreking	Hoe moet ik me gedragen? - Met kennis van beperkingen als gevolg van slechthorendheid: auditief, auditief-visueel, talig, emotioneel - Omgaan met doofheid ouders, begrip voor gebruik gebaren, zich kunnen verplaatsen in hun perspectief/achtergrond - Counseling CI-kinderen en/of ouders, stimuleren/motiveren o.a. in actieve revalidatiefase
Toepassen Analyseren *Bewerkstellig, voer uit, gebruik, pas toe, vergelijk, organiseer, haal uit elkaar, ondervraag, vind*		**Productief handelen**	Wat moet ik kunnen bedenken, beredeneren? - Indicatiestelling CI, op welk moment doorverwijzen naar CI-team, bepalende factoren - Te verwachten resultaat CI en actie ondernemen als resultaat minder dan verwacht - Herkennen complicaties die collegiaal overleg behoeven.	Wat moet ik volgens plan kunnen uitvoeren? - Het beoordelen van technische integriteit CI (extern materiaal, impedanties) - Metingen op de ok (in ieder geval impedanties en NRT) - Het bepalen van stimulatieniveaus onder- en bovengrens (oudere kinderen). - Complexe casussen analyseren en behandelplan opstellen (speciale pathologie, MG-kinderen, tegenvallend resultaat)	Hoe moet ik samenwerken of omgaan met anderen? - Communicatie in spreekkamer afstemmen op niveau en acceptatiefase ouders - Tijdige en heldere communicatie met andere disciplines binnen eigen team - Contact onderhouden met gezinsbegeleiding/ambulante begeleiding

Evalueren **Creëren** *Controleer, hypothetiseer, bekritiseer, experimenteer, beoordeel, ontwerp, maak, plan, produceer, vind uit, bouw*		**Zelfsturend handelen**	Wat moet ik kunnen doen om te verbeteren? - *Herkennen van kennislacunes* - *Literatuuronderzoek kunnen uitvoeren* - *Op basis van theoretische kennis tot een oplossing komen voor de kennis- en kwaliteitslacunes.*	Wat moet ik kunnen uitvoeren in de praktijk? - Op basis van zorgvraag kunnen bepalen welke metingen nodig zijn en tijdens een meting eventueel de onderzoeken aanvullen voor een goede diagnostiek - Controleren/interpreteren van meetgegevens en verslaglegging, zowel zelf uitgevoerde als van collega's	Hoe moet ik me kunnen verantwoorden? - *Juiste vragen kunnen stellen om zorgvraag helder te krijgen* - *Helder ideeën kunnen verwoorden* - *Collega's kunnen motiveren* - *Feedback aan collega's kunnen geven zodanig dat er een veilige leeromgeving is* - *Verantwoordelijkheid kunnen nemen voor de borging van de kwaliteit binnen het AC.*

*Aanvullend aan kennisniveau zoals opgedaan bij EPACI volwassenen en CI kind revalidatie

Hoofddoel: Je hebt als KF Audioloog kennis van de werking en pathofysiologie van het evenwichtsorgaan en kunt onderzoeken naar de werking van het evenwichtsorgaan interpreteren.

Prestatiematrix EPA 7: Vestibulair **Supervisie eindniveau : 2** **Bekwaamheidsniveaus**			**Handelingscategorieën** **Cognitief – reflectief** *Weten, denken*	**Vakmatig – methodisch** *Systematisch handelen*	**Sociaal – communicatief** *Communiceren*
Onthouden Begrijpen *Beschrijf, herken, benoem, interpreteer, vat samen, leg uit, classificeer, hernoem*		**Reproductief Handelen**	Wat moet ik weten, begrijpen? - Anatomie en werking van het evenwichtsorgaan - Problemen en klachten die kunnen optreden bij dysfunctie van het evenwichtsorgaan - Metingen aan het evenwichtsorgaan - Kennis van mogelijke diagnoses - Kennis van mogelijke behandelingen en mogelijk herstel. - Kennis van diverse diagnostische testen: bemeten van spontane nystagmus, oculomotoriek (fixatie, gladde oogvolgbeweging, saccades, optokinetische nystagmus), vestibulo-oculaire reflex bij draaistop, pendel, calorisatie en head impulse. Testen en behandeling van BPPD (m.n. bevrijdingsmanoeuvres voor de posterieure en horizontale SCC)	Wat moet ik kunnen? - Anamnese afnemen - Weten welke protocollen er zijn voor vestibulaire diagnostiek en behandeling	Hoe moet ik me gedragen? - Om kunnen gaan met patiënten die last hebben van duizeligheid - Om kunnen gaan met bezorgde of angstige patiënten - Om kunnen gaan met slechthorende patiënten
Toepassen Analyseren *Bewerkstellig, voer uit, gebruik, pas toe, vergelijk, organiseer, haal uit elkaar, ondervraag, vind*		**Productief handelen**	Wat moet ik kunnen bedenken, beredeneren? - Herkennen van klachten/afwijkingen die kunnen ontstaan bij: normaal functionerende evenwichtsorganen, brughoekproces, acute eenzijdige uitval, M. Ménière, bilaterale hypofunctie, centrale problematiek, BPPD, BVL, PPPD, SCDS.	Wat moet ik volgens plan kunnen uitvoeren? - Uitvoering van bovenstaande diagnostische testen (NB: tot supervisieniveau 2) - Uitslagen interpreteren - Uitleg geven over de testen - Verslaglegging en communicatie met patiënt en/of verwijzer	Hoe moet ik samenwerken of omgaan met anderen? - Instructies afstemmen op de patiënt - Feedback van collega's kunnen ontvangen - Overleg initiëren met collega's, artsen, externe verwijzers - Kort en duidelijk rapporteren aan collega's en andere specialisten

			- Herkennen complicaties die collegiaal overleg behoeven		
Evalueren **Creëren** *Controleer, hypothetiseer, bekritiseer, experimenteer, beoordeel, ontwerp, maak, plan, produceer, vind uit, bouw*		**Zelfsturend handelen**	Wat moet ik kunnen doen om te verbeteren? - *Herkennen van kennislacunes* - *Literatuuronderzoek kunnen uitvoeren* - *Op basis van theoretische kennis tot een oplossing komen voor de kennis- en kwaliteitslacunes.*	Wat moet ik kunnen uitvoeren in de praktijk? - Op basis van zorgvraag kunnen bepalen welke metingen nodig zijn en tijdens een meting eventueel de onderzoeken aanvullen voor een goede diagnostiek - Controleren/interpreteren van meetgegevens en verslaglegging, zowel zelf uitgevoerde als van collega's	Hoe moet ik me kunnen verantwoorden? - *Helder ideeën en oplossingen kunnen verwoorden* - *Collega's kunnen motiveren* - *Feedback aan collega's kunnen geven zodanig dat er een veilige leeromgeving is* - Na/bijscholing aan laboranten of andere medewerkers (aios)

NB: de schuingedrukte onderwerpen komen nog terug in latere EPA beschrijvingen, en vallen buiten het supervisie eindniveau van dit betreffende EPA.

Hoofddoel: Je kunt als KF Audioloog, als hoofdbehandelaar, de status en voorgang van de spraak-taal – en algemene ontwikkeling (laten) vaststellen, en bent in staat om in een multidisciplinair team, met aandacht voor wensen van de zorgvragers, een behandelplan op te (laten) stellen.

Prestatiematrix EPA 8: Spraak-taal ontwikkeling kinderen **Supervisie eindniveau : 4** **Bekwaamheidsniveaus**			**Handelingscategorieën** **Cognitief – reflectief** *Weten, denken*	**Vakmatig – methodisch** *Systematisch handelen*	**Sociaal – communicatief** *Communiceren*
Onthouden **Begrijpen** *Beschrijf, herken, benoem, interpreteer, vat samen, leg uit, classificeer, hernoem*		**Reproductief Handelen**	Wat moet ik weten, begrijpen? - Basiskennis auditieve ontwikkeling kind normaal en afwijkend. - Basiskennis spraak- en taalontwikkeling kind normaal en afwijkend. - Basiskennis meertalige taalontwikkeling kind normaal en afwijkend - Basiskennis algehele ontwikkeling kind normaal en afwijkend. - Basiskennis diagnose TOS. - Basiskennis zorgadministratie en DOT declaratie. - Basiskennis sociale kaart: logopedie in vrije vestiging, cluster II onderwijs, Jeugd GGZ, overige behandelgroepen. - Basiskennis testmogelijkheden auditief, spraak/taal en algehele ontwikkeling. - Basiskennis over inhoud van andere specialismes (orthopedagoog, logopedisten, linguïst).	Wat moet ik kunnen? - Weten welke werkinstructies en protocollen er zijn voor diagnostiek en zorg rondom spraak-taal ontwikkeling. - Anamnese met als doel om adequaat door te verwijzen naar spraaktaalteam bij zorgen over spraaktaalontwikkeling. - EPA kinderdiagnostiek op supervisieniveau 3.	Hoe moet ik me gedragen? - Nauwkeurig en systematisch werken. - Beheersen van gesprekstechnieken voor verschillende leeftijden. - Weten wanneer je collega's van andere specialismes kunt inschakelen.
Toepassen **Analyseren** *Bewerkstellig, voer uit, gebruik, pas toe, vergelijk, organiseer, haal uit elkaar, ondervraag, vind*		**Productief handelen**	Wat moet ik kunnen bedenken, beredeneren? - Samenhang kunnen zien tussen observaties (ook van leerkrachten, ouders, …) en diagnostiek van auditief functioneren, spraaktaal ontwikkeling, cognitieve ontwikkeling	Wat moet ik volgens plan kunnen uitvoeren? - Intake- en uitslaggesprekken voeren (m.n. over gehoor/auditief functioneren). - Complexe casussen (laten) analyseren en behandelplan opstellen.	Hoe moet ik samenwerken of omgaan met anderen? - Gesprekstechnieken afstemmen op niveau en acceptatiefase ouders. - Gesprekstechnieken afstemmen op leeftijd kind.

			sociaal-emotionele ontwikkelen en medische pathologie - Meewerken vanuit expertise in eigen discipline en discipline overstijgen kennis aan de interdisciplinaire diagnose –stelling en beleidsvorming	- Adequaat doorverwijzen naar externe netwerkpartners en disciplines.	- Samenwerken met collega's van andere disciplines op hoog professioneel niveau. - Collega's van andere specialismes inschakelen op het juiste moment. - Op een doelmatige manier MDO kunnen voorzitten.
Evalueren **Creëren** *Controleer, hypothetiseer, bekritiseer, experimenteer, beoordeel, ontwerp, maak, plan, produceer, vind uit, bouw*		**Zelfsturend handelen**	Wat moet ik kunnen doen om te verbeteren? - *Literatuuronderzoek kunnen uitvoeren en reflecteren.* - *Op basis van theoretische kennis tot een oplossing komen voor de kennis- en kwaliteitslacunes.* - *Intervisie binnen en buiten de eigen discipline*	Wat moet ik kunnen uitvoeren in de praktijk? - In een team een behandelplan opstellen. - Evalueren van geleverde zorg en behandeling voor individuele casus en op groepsniveau .	Hoe moet ik me kunnen verantwoorden? - *Juiste vragen kunnen stellen om zorgvraag helder te krijgen.* - *Helder ideeën kunnen verwoorden.* - *Collega's kunnen motiveren.* - *Feedback aan collega's kunnen geven en ontvangen, zodanig dat er een veilige leeromgeving is.*

NB: de schuingedrukte onderwerpen komen nog terug in latere EPA beschrijvingen, en vallen buiten het supervisie eindniveau van dit betreffende EPA.

Hoofddoel:
Je kunt als Klinisch Fysicus-Audioloog, voor een zorgvrager, klachten gerelateerd aan tinnitus en geluidsgevoeligheid (audiologisch, psychosociaal, medisch) *diagnosticeren*, weet ze in communicatie met zorgvrager te *structureren,* en bent in staat om in een multidisciplinair team, met aandacht voor wensen van de zorgvrager, een individueel *behandelplan* op te stellen.

Prestatiematrix EPA 9: Tinnitus en Geluids-gevoeligheid (T&GG) **Supervisie eindniveau: 4**			**Handelingscategorieën**		
			Cognitief – reflectief *Weten, denken*	**Vakmatig – methodisch** *Systematisch handelen*	**Sociaal – communicatief** *Communiceren*
Bekwaamheidsniveaus					
Onthouden Begrijpen *Beschrijf, herken, benoem, interpreteer, vat samen, leg uit, classificeer, hernoem*		**Reproductief Handelen**	Wat moet ik weten, begrijpen? - Pathofysiologie van tinnitus en geluidsgevoeligheid - Gebruikelijke auditieve, psychologische en medische klachten bij T&GG - Psychologische modellen van T en GG - Neurobiologie van tinnitus - Gebruikelijke comorbiditeiten (bijv. stemmingsproblemen) en uitingsvormen daarvan (bijv. vermijding of maskering)	Wat moet ik kunnen? - EPA Volwassen Revalidatie, minimaal op niveau 3 - Kennis van protocollen voor tinnitus-diagnostiek en revalidatie (o.m. KNO-richtlijn, Britse BTA, Stichting Hoormij) - Weten hoe de zorg (nationaal, regionaal, lokaal) en de zorglijn ingericht is - Weten welke vakinhoudelijke en sturende rol de KFA in het MDO inneemt, en kennis van de complementaire expertise van samenwerkende zorgprofessionals	Hoe moet ik me gedragen? - Rustig en duidelijke spreektempo - Heldere gesprocsstructuur (inclusief inleiding, afsluiting en follow-up) - Gedegen uitvraag naar aard en karakter van klachten, met gestructureerde anamnese - Empathische en motiverende gesprekstijl - Nauwe balans bewaken tussen enerzijds geruststelling, anderzijds serieus nemen van klachten. - Verantwoordelijk
Toepassen Analyseren *Bewerkstellig, voer uit, gebruik, pas toe, vergelijk, organiseer, haal uit elkaar, ondervraag, vind*		**Productief handelen**	Wat moet ik kunnen bedenken, beredeneren? - Onderscheid maken tussen audiologische, psychosociale en medische klachten, met oog voor onderlinge samenhang - Indicatie voor lichte zorg (info-bijeenkomst / groepseducatie / zelfhulpboek) of juist zwaardere zorg (individuele counseling en behandeling) - Indicatie voor toepassen van hoortoestellen ter behandeling van tinnitus en/of correct gedoseerd gebruik van andere hulpmiddelen	Wat moet ik volgens plan kunnen uitvoeren? - Psycho-educatie over factoren van invloed op klachten, in groep en op individueel niveau. Goede uitleg is een eerste onderdeel van behandeling. - Voorschrijven van technische hulpmiddelen bij gehoorverlies (zoals bij volwassen-revalidatie)	Hoe moet ik samenwerken of omgaan met anderen? - Instructies afstemmen op niveau van de zorgvrager - In MDO gedegen afweging tussen inbreng van audiologische expertise en sturing van team - Zorgvuldig afwegen van behandelopties (in team) - Welke behandeling is beschikbaar binnen het AC en welke daarbuiten? Inzicht in zorgkaart en verantwoordelijkheden van

			- Indicatie voor indivuele psychologische interventie (CGT4T) of juist eerder behandeling in groep: afwegen in team		zorgprofessionals, bijv. bij uitingen van suïcidaliteit. - Feedback en intervisie van collega's kunnen ontvangen -
Evalueren **Creëren** *Controleer, hypothetiseer, bekritiseer, experimenteer, beoordeel, ontwerp, maak, plan, produceer, vind uit, bouw*		**Zelfsturend handelen**	Wat moet ik kunnen doen om te verbeteren? - *Herkennen van kennislacune' s bij jezelf en waar mogelijk ook bij teamleden* - Herkennen van onder- of overbehandeling, in de zorglijn of in individuele gevallen - *Literatuuronderzoek kunnen uitvoeren, samenvatten en reflecteren* - *Op basis van theoretische kennis tot een oplossing komen voor de kennis- en kwaliteitslacunes.*	Wat moet ik kunnen uitvoeren in de praktijk? - Afstemmen van psycho-educatie op individuele behoeften van zorgvrager - Structureren van klachten en mogelijke behandelingen (audiologisch – psychologisch – medisch) - Samenvatten van klachten in MDO - In team opstellen van behandelplan - Evalueren van geleverde zorg en behandeling	Hoe moet ik me kunnen verantwoorden? - *Juiste vragen kunnen stellen om zorgvraag helder te krijgen* - *Bij zorgvrager behoefte en uitkomst checken* - *Helder ideeën kunnen verwoorden* - *Collega's kunnen motiveren* - *Feedback aan collega's kunnen geven zodanig dat er een veilige leeromgeving is*

NB: de schuingedrukte onderwerpen komen nog terug in latere EPA beschrijvingen, en vallen buiten het supervisie eindniveau van dit betreffende EPA.