Supplement I of Annexe II of the guidelines for the acquisition of the SSRMP Certification in Medical Physics

Concept for the acquisition of the evidence of radiation protection expertise for SSRMP certified Medical Physicists in Switzerland

Introduction

In accordance with the radiation protection ordinance (814.501) and the radiation protection training ordinance (814.501.261), a mandatory training in radiation protection is needed for getting the SSRMP certification as a medical physicist (group MP 1). This training consists of up to 120 lessons.

This document provides a detailed description, how this training is organized. Generally, SSRMP is not organizing the complete radiation protection course for medical physicists but SSRMP is providing a syllabus on how to get the knowledge and the competences, which are associated with such a training in radiation protection. This syllabus has been mutually developed between representatives of SSRMP and Federal Office of Public Health (FOPH).

Basically, the training in radiation protection is separated into two parts:

a) An individual candidate has to successfully pass a certified radiation protection expert training (I 1) dealing with unsealed radioactive sources such as for instance the B/C courses at PSI or IRA, which consist of 80 lessons
b) An additional medical physics related radiation protection training in clinical practice has to be successfully passed, which corresponds to up to 40 lessons

In the following, only the additional training b) is described, since the training a) is well established in Switzerland already. In the following, this additional training is called “medical physics related radiation protection training in clinical practice”.

Learning objectives of medical physics related radiation protection training in clinical practice

In General

- Extend the knowledge and the competences, which were already achieved by the previously accomplished radiation protection expert training (B/C), in particular
  - Perform radiation protection in clinical practice
  - Transfer theoretical knowledge to practical applications
  - Apply legal law and ordinances, guidelines, recommendations, and protocols
  - Evaluate and name risks and uncertainties in clinical practice
- Get the medical physics related competences associated to the radiation protection training ordinance (814.501.261)

More specific learning objectives

- Identify the clinical needs with respect to radiation protection
- Recognize the approaches for implementing radiation protection topics in clinics
- Recognize the challenges of dealing with radiation protection in a clinical environment
- Evaluate the science underlying the current procedures of radiation protection
- Assess the resources needed in order to take over the responsibilities associated to a clinical medical physicist
- Analyze the costs related to radiation protection
- Recognize the differences between quality management, quality control, and quality assurance
- Identify the needs of other professions such as administrative staff or architects
- Identify the practical limitations with respect to construction of shielding bunkers (e.g. ducts, density challenges) and get familiar with corresponding solutions
- Identify resources useful for clinical practice
- Apply national and international laws, guidelines, recommendations
- Label procedures, which can be seen as „best practices"
- Analyze expected doses for patients, staffing and other persons in clinics
- Discuss justification and optimization procedures in the context of radiation protection with peers
- Demonstrate the usefulness and perform appropriate handling of patient shielding approaches
- Investigate and design internal manuals and procedures of a clinic
- Explore critical incidence reporting systems applied in clinics
- Apply concepts like FMEA and fault tree
- Perform different administrative tasks in the field of radiation protection such as license requests, archiving, reporting
- Identify current trends in medicine and their link to radiation protection
- Review and design emergency procedures in the context of radiation protection

Competence acquisition

- Become competent
  - As a medical physicist working in clinical practice with respect to radiation protection according to the radiation protection training ordinance ("Ausbildungsverordnung") such that the individual candidate is able to perform all the activities described in "Anhang 2, Tabelle 1, MP1/2" and getting the competences described in "Anhang 2, Tabelle 2, MP1/2"
  - In estimating risks related to doses by ionizing radiation for different medical procedures
  - In recognizing causes and solutions to issues related to both underdose as well as overdose
  - In dealing with different perceptions of risks by patients, staff and other persons
  - On how to develop a quality management program in the context of radiation protection
  - In writing internal directives for procedures and working behaviors to staff members related to radiation protection
  - In organizing and executing education programs, in particular continuous education programs, for staff members in the context of radiation protection

Contents of medical physics related radiation protection training in clinical practice

Topic		Time[1] [h]
Radiation therapy		**14**
RT1	Bunker shielding in radiation therapy	4
RT2	Dose estimation and optimization for IGRT	2
RT3	Second cancer incidence in radiation therapy	1
RT4	Patient's safety and risks and CIRS in radiation therapy	1
RT5	Radiation protection for brachytherapy	1
RT6	Patient and staff protection in radiation therapy	2
RT7	Quality assurance in radiation therapy	2
RT8	Documentation	1
Nuclear Medicine		**14**
NM1	Dose reference levels (DRLs) in nuclear medicine	1
NM2	Risk assessment and CIRS	1
NM3	Formalism and application of internal dosimetry	1
NM4	Patient-specific dosimetry	1
NM5	Patients and staff protection in nuclear medicine	1
NM6	Therapy with open sources	2
NM7	Concept of effective dose, equivalent dose and absorbed dose and its application in clinical practice	1
NM8	Radiation shielding considerations	2
NM9	Quality assurance in nuclear medicine	2
NM10	Waste management in nuclear medicine	1
NM11	Documentation	1
Radiology		**14**
IM1	Dose reference levels (DRLs) in radiology	2
IM2	Patient dosimetry in radiology	3
IM3	Patients and staff protection in radiology	3
IM4	Shielding in radiology	2
IM5	Quality assurance in radiology	2
IM6	Patient's safety and risks and CIRS in radiology	1
IM7	Documentation	1

In the following, the different topics are described in more details. In this context it is important to mention that while candidates aiming for the certification in radiotherapy physics have to perform all three topics (Radiation therapy, Nuclear medicine and Radiology), the candidates aiming for the certificate in Imaging only have to perform the topic Nuclear Medicine and Radiology.

[1] Although, the training is not performed by lectures, it's useful to give an estimate about the time needed to get trained about a certain topic.

Radiation Therapy

RT1: Bunker shielding in radiation therapy

- Perform bunker shielding topics in clinical practice
- Identify the license application process in the context of linear accelerators for medical purposes
- Recall the physics underlying bunker shielding calculations
- Apply the legal texts related to bunker shielding such as Beschleuniger-Verordnung
- Explain the impact of neutron activation by photo-nuclear processes
- Use a clinical example of a bunker shielding plan and check for consistency
- Apply the SSRMP rec. No. 11 about linac quality assurance and investigate its relevance for bunker shielding
- Perform dose measurements in order to validate the calculated shielding parameters
- Assess challenging situations such as doors, ducts, maze, etc.
- Evaluate possibilities to reduce costs associated to radiation protection

RT2: Dose estimation and optimization for IGRT

- Recall the physics underlying IGRT including margin concepts and their link to dose optimization
- Investigate the relationship of imaging dose and image quality in the context of IGRT
- Apply the legal texts related to IGRT dose reporting
- Assess the typical dose values of different imaging procedures used in IGRT: 2D, 3D, 4D, kV, MV, CBCT, stereotactic imaging, etc.
- Compare the clinical procedures with the two “Stellungnahmen” by KSR from 2009 and 2017[2]

RT3: Second cancer incidence in radiation therapy

- Identify literature and explore the underlying basics of second cancer incidences in radiation therapy
- Discuss with peers (e.g. local radiation oncologists) and formulate procedures on how to check treatment plans with respect to second cancer

RT4: Patient’s safety and risks and CIRS in radiation therapy

- Identify literature and explore the underlying basics of safety procedures and critical incident reporting systems (CIRS) in radiation therapy
- Deal with uncertainties in current daily practices of radiation therapy
- Develop skills to communicate risks together with local peers (e.g. medical physicist, RTT, medical doctors)
- Apply methods like FMEA and fault tree analysis and check with literature (e.g. AAPM TG-100)

[2] https://www.bag.admin.ch/bag/de/home/das-bag/organisation/ausserparlamentarische-kommissionen/eidgenoessische-kommission-fuer-strahlenschutz-ksr.html

RT5: Radiation protection for brachytherapy

- Identify the fundamental differences between HDR and LDR procedures with respect to radiation protection
- Formulate emergency procedures in brachytherapy and discuss with local peers about responsibilities and duties
- Design worst case scenarios (patient, staff, equipment related) and develop action plans, which are then discussed with the local peers (i.e. certified medical physicist)

RT6: Patient and staff protection in radiation therapy

- Identify the locally given manuals/quality handbooks in the context of personnel dosimetry
- Analyze the administrative procedures of personnel dosimetry such as reporting and organization of dosimeters and categorization of A and B workers
- Evaluate the potentials, the challenges and the pitfalls of using shielding materials in radiation therapy and discuss it with the local peers
- Derive the basic physics underlying in the context of radiation protection and shielding materials for photon beams in the MV energy range
- Compare the different influences of scatter and imaging doses for different applications in radiation therapy

RT7: Quality assurance in radiation therapy

- Explore the SSRMP recommendations No. 11 (linac), 13 (brachy), 15 (IMRT), 16 (IGRT) and evaluate their implementations in the local environment (on site)
- Evaluate these recommendations according to their relationships to radiation protection issues

RT8: Documentation

- The candidate has to provide a logbook (hard copy or electronic form are both accepted) containing a record of training experiences with comments, exercises and examples and submit that logbook to the mentor. The documentation should include at least an example of a calculated bunker shielding situation for linac based radiation therapy.

Literature, Resources

- Beschleuniger-Verordnung (814.501.513)
- SSRMP recommendations (sgsmp.ch)
- E.B. Podgorsak, Radiation Oncology Physics: A Handbook for Teachers and Students, IAEA website

Nuclear medicine

NM1: Dose reference levels (DRLs) in nuclear medicine

- Derive the definition of dose reference level (DRL) in nuclear medicine
- Identify the national DRLs for nuclear medicine
- Apply DRLs in the process of optimization and evaluate potential patient dose reduction in nuclear medicine
- Discuss the implementation of dose monitoring in clinical environment

NM2: Risk assessment and CIRS

- Apply the ALARA concept and radiation safety precautions in nuclear medicine diagnostic and therapeutic procedures
- Analyze the methods for estimating effective dose to the patient from diagnostic nuclear medicine scans
- Identify the risks associated with radiation exposure
- Explore the procedures for risk assessment
- Identify the structure of a critical incidence reporting system (CIRS)
- Investigate the implementation and maintenance of the physics aspects of the quality system and the CIRS
- Develop skills to communicate risk or lack of risk in the context of dose estimation and justification

NM3: Formalism and application of internal dosimetry

- Recall the established formalisms for internal dose calculations
- Calculate absorbed dose to organs according to MIRD formalism
- Calculate the dose for specific clinical applications such as SIRT

NM4: Patient-specific dosimetry

- Identify tools for performing patient-specific internal dosimetry
- Calculate patient-specific dosimetry from repeat images and uptake measurements
- Evaluate the relationship between dose and image quality

NM5: Patients and staff protection in nuclear medicine

- Recall the methods for estimating effective dose to the patients and staff (external and internal)
- Explore the locally given manuals/quality handbooks in the context of personnel dosimetry
- Analyze the administrative procedures of personnel dosimetry such as reporting and organization of dosimeters and categorization of A and B workers
- Evaluate the potentials, the challenges and the pitfalls of using shielding materials in nuclear medicine and discuss it with the local peers
- Derive the basic physics underlying in the context of radiation protection and shielding materials for the energy range given by the used radionuclide
- Evaluate the differences and the radiation protection related challenges when comparing automatic with manual injection procedures

NM6: Therapy with open sources

- Recall the principles of radionuclide therapy
- Identify the facility design for radionuclide therapy
- Apply radiation safety precautions for therapy using unsealed sources
- Develop skills to give advice to staff, patients and others regarding radiation risk
- Evaluate the radiation protection regulations to personnel, patients and members of the public associated with radionuclide therapy
- Develop skills to communicate risks together with local peers

NM7: Concept of effective dose, equivalent dose and absorbed dose and its application in clinical practice

- Recall the definitions of absorbed dose, effective dose and equivalent dose
- Discuss the linear-non-threshold model
- Identify when and how to use these concepts in nuclear medicine

NM8: Radiation shielding considerations

- Recall the principles and requirements of shielding design for radionuclide energies used for diagnostic nuclear medicine purposes
- Explore the shielding requirements for PET, SPECT in combination with other imaging modalities
- Design appropriate radiation shielding strategies for different types of nuclear medicine equipment
- Identify the license application process in the context of nuclear medicine for medical purposes

NM9: Quality assurance in nuclear medicine

- Identify the structure of a quality system
- Recall the procedures for acceptance testing as well as verification of the equipment performance after maintenance
- Explore the commissioning, acceptance and quality control of a dose calibrator
- Explore the commissioning, acceptance and quality control of of gamma camera/SPECT and CT systems
- Explore the commissioning, acceptance and quality control of PET
- Perform SUV calibration and check SUV calibration accuracy

NM10: Waste management in nuclear medicine

- Perform radioactive waste management for the sources used in a nuclear medicine department (liquid and solid) and investigate the usage of a “Abklinganlage” and explore the correct handling of “Abwasser”

NM11: Documentation

- The candidate has to provide a logbook (hard copy or electronic form are both accepted) containing a record of training experiences with comments, exercises and examples and submit that logbook to the mentor. The documentation should include at least a one-page summary on how to perform radiation protection for I-131 treatments in clinical practice.

Literature, Resources

- Ordinance about radioactive sources (UraM, 814.554)
- Directives (“Wegleitungen”) by FOPH[3]
- D.L. Bailey, J.L. Humn, A. Todd-Pokropek, A. Van Aswegen, Nuclear Medicine Physics: A Handbook for Teachers and Students, IAEA website
- https://www.iaea.org/resources/rpop

[3] https://www.bag.admin.ch/bag/de/home/gesetze-und-bewilligungen/gesuche-bewilligungen/bewilligungen-aufsicht-im-strahlenschutz/wegleitungen.html

Radiology

IM1: Dose reference levels (DRLs) in radiology

- Derive the definition of dose reference level (DRL) in radiology
- Identify the national DRLs for different applications in radiology such as radiography, fluoroscopy, CT, etc.
- Apply DRLs in the process of optimization and evaluate potential patient dose reduction in radiology

IM2: Patient dosimetry in radiology

- Recall the physics underlying patient dosimetry in radiology
- Calculate and estimate patient dose for different applications in radiology
- Analyze the different methods to describe and assess image quality in clinical practice

IM3: Patients and staff protection in radiology

- Analyze how to optimize dose for the patient and how this is correlated to image quality
- Explore influences of technical parameters as well as user interactions to the dose of patients and staff
- Use dose indices given in different disciplines such as radiography, fluoroscopy, CT, etc.
- Discuss the implementation and the relevance of dose monitoring in clinical environment

IM4: Shielding in radiology

- Identify the license application process in the context of radiology
- Carry out shielding topics in clinical practice with a special focus on CT and fluoroscopy
- Recall the physics underlying shielding calculations
- Explore the legal texts related to shielding such as Röntgen-Verordnung
- Use a clinical example of a shielding plan and check for consistency
- Perform dose measurements in order to validate the calculated shielding parameters
- Investigate challenging situations such as doors
- Evaluate possibilities to reduce costs associated to radiation protection

IM5: Quality assurance in radiology

- Recall the basic quality assurance concepts in radiology
- Identify the structure of a quality system
- Identify the license related duties with respect to quality assurance procedures and explore the Röntgen-Verordnung
- Evaluate the implementation and maintenance of the physics aspects of the quality system
- Recall the procedures for acceptance testing as well as verification of the equipment performance after maintenance

IM6: Patient's safety and risks and CIRS in radiology

- Identify literature and explore the underlying basics of safety procedures and critical incident reporting systems (CIRS) in radiology
- Deal with uncertainties in current daily practices of radiology
- Develop skills to communicate risks together with local peers (e.g. medical physicist, RTT, medical doctors)

IM7: Documentation

- The candidate has to provide a logbook (hard copy or electronic form are both accepted) containing a record of training experiences with comments, exercises and examples and submit that logbook to the mentor. The documentation should include at least an example of a calculated shielding situation for fluoroscopy and CT.

Literature, Resources

- Röntgen-Verordnung (814.542.1)
- Directives ("Wegleitungen") by FOPH[4]
- D.R. Dance, S. Christofides, A.D.A. Maidment, I.D. McLean, K.N. Ng, Diagnostic Radiology Physics, A Handbook for Teachers and Students, IAEA website
- https://www.iaea.org/resources/rpop

[4] https://www.bag.admin.ch/bag/de/home/gesetze-und-bewilligungen/gesuche-bewilligungen/bewilligungen-aufsicht-im-strahlenschutz/wegleitungen.html

Successful completion

The training in radiation protection for medical physicists is seen to be successfully completed, if all of the following conditions are fulfilled:

1. Candidate is accepted by the SSRMP Fachkommission as a candidate for the SSRMP certification.
2. Candidate shows that he/she successfully passed a certified radiation protection expert training such as the B/C courses by PSI or IRA or this training is individually recognized by the FOPH.
3. Candidate has written consensus (i.e. signature by mentor[5]) by his/her mentor that the competence and topics described above (RT 8, NM 11, IM 7) have been acquired and were performed accordingly.
   In case of foreign certified medical physicists missing a formalized training in radiation protection in clinical practice as described above (RT 8, NM 11, IM 7), the candidate has to provide to the SSRMP all documents demonstrating the completion of the training in radiation protection in clinical practice and the corresponding tasks without the need of a mentor's signature.
4. Candidate has handed in all documents mentioned above under 2 and 3 to SSRMP education committee chair and SSRMP education committee gave written agreement (i.e. signature by education chair) to the candidate.

Evaluation of the training

This concept for the acquisition of the "Strahlenschutz-Sachverständigen-Nachweis" for SSRMP certified Medical Physicists in Switzerland is to be evaluated such that the quality of the training can be guaranteed. For this purpose, the involved mentors and candidates are going to be asked (e.g. by a questionnaire) about their accomplishments, challenges, and problems when dealing with the described on-the-job training. In addition, on the occasion of the well-established platform of SSRMP's applied medical physics (AMP) working group, this training concept and the related experiences of candidates as well as mentors can be discussed.

[5] The qualifications of being a mentor are described in the corresponding rules on SSRMP certification, which can be found on ssrmp.ch