European Qualifications Framework (EQF) Level 6 Benchmarking Document: **Radiographers**

Second Edition
January 2018

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Contents

Procedure

The first edition of this document was approved by the EFRS General Assembly in November 2013 [1]. To evaluate its value for the national societies and educational institutions the EFRS membership was surveyed in 2017 [2].

This second edition of the **EFRS European Qualification Framework Level 6 Benchmark Document for Radiographers (EFRS EQF level 6)** is a revision of edition one and was drafted by a group of experts with input from the EFRS expert committees for Medical Imaging, Nuclear Medicine (with the support of the European Association of Nuclear Medicine (EANM) technologists committee) and Radiotherapy for their specific fields.

It was decided to leave the chapter with the Radiation Protection Knowledge, Skills and Competence tables (KSC's) as agreed at the European level in the Medical Radiation Protection Education & Training (MEDRAPET) project (2013) as an appendix.

The draft revision was sent to all member organisations for comments in September 2017 and was discussed and approved in the EFRS Annual General Meeting in November 2017.

Purpose of this document

The purpose of the EFRS EQF level 6 benchmark document for radiographers is to serve as a benchmark;

- informing readers about what the EFRS membership agreed to be the entrée level to the radiography profession in Europe and
- as a point of reference for use by professional bodies, educational institutions, employers, and other relevant bodies throughout Europe.

Background information

Education and role of the radiographer in Europe

The science and practice of radiography is over a hundred years old and from the very beginning the story of radiography has been one of constant, rapidly changing and ever-expanding technology and their education constantly has to keep pace with this.

Repeated EFRS education surveys show that In Europe there are a range of providers of radiography education, including vocational colleges and universities, following the descriptors of the European Qualification Framework (EQF) at level 4, 5, 6 (Bachelor), 7 (Master) and 8 (Doctoral).

The EFRS survey 2017 [3] shows that for the initial qualification there is an ongoing move from vocational education to formal Higher Education. From 38 societies 80% replied that their initial qualification is at level 6 (Bachelor) from these 79% replied that their curriculum is combined for medical imaging, nuclear medicine and radiotherapy. 10% run separate courses.

Harmonisation of radiographer education and qualification frameworks in Europe

For many years European radiographer societies are cooperating with the aim to harmonise the education and role of the radiographer in Europe. However harmonisation of education can be the result of the actions described below, content and level of education programmes remain a national responsibility and the role depends upon hospital and service policies.

In 1995 the European subgroup of the International Society of Radiographers and Radiological Technologists (ISRRT) published "The Role of the radiographer in Europe" where the role and responsibilities of a radiographer are described.

From 2002 until 2008 a number of professional societies and educational institutions were involved in the Higher Education Network for Radiography in Europe (HENRE), which was a Socrates / Erasmus funded thematic network. HENRE developed a methodology which is laid down in the "Tuning Template for radiography in Europe" [4, 5] to design and deliver first cycle degree programmes using a learning outcomes and competence framework, based on the **Qualification Framework of the European Higher Education Area** (QF-EHEA).

Developed between 2007 and 2009 this QF-EHEA provides descriptors for cycles [6, 7]. Each cycle descriptor offers a generic statement of typical expectations of achievements and abilities associated with qualifications that represent the end of that cycle.

1. The descriptor for the higher education short cycle (within or linked to the first cycle), developed by the Joint Quality Initiative as part of the Bologna process, corresponds to the learning outcomes for EQF level 5.
2. The descriptor for the first cycle in the Framework for Qualifications of the European Higher Education Area corresponds to the learning outcomes for EQF level 6.
3. The descriptor for the second cycle in the Framework for Qualifications of the European Higher Education Area corresponds to the learning outcomes for EQF level 7.
4. The descriptor for the third cycle in the Framework for Qualifications of the European Higher Education Area corresponds to the learning outcomes for EQF level 8.

In 2008 the **European Qualification Framework** (EQF) was agreed by the European Commission and Parliament and is now into practice across Europe.

39 European countries are currently involved in its implementation.

The EQF is focused on the outcome of learning and the person's actual knowledge and skills rather than the amount of study needed to complete the qualification programme. It acts as a translation device to make national qualifications more readable across Europe, promoting workers' and learners' mobility between countries and facilitating their lifelong learning.

Through validation of non-formal and informal learning European countries are emphasising the need to recognise an individual's knowledge, skills and competences – those acquired not only at school, university or other education and training institutions, but also outside the formal system. For the validation of the acquired competences European guidelines have been published.

References

[1] European Federation of Radiographer Societies. European Qualifications Framework (EQF) Level 6 Benchmarking Document: Radiographers. Utrecht, the Netherlands: European Federation of Radiographer Societies; 2014. Available from: http://bit.ly/EQF_BDR

[2] European Federation of Radiographer Societies. An analysis of the value and use of the European Qualification Framework Level 6 Benchmarking Document: Radiographers. Utrecht, the Netherlands: European Federation of Radiographer Societies; 2017. Available from: http://www.efrs.eu/publications

[3] European Federation of Radiographer Societies. EFRS Education Survey. Utrecht, the Netherlands: European Federation of Radiographer Societies; 2017. Available from: http://www.efrs.eu/publications

[4] Tuning Template for Radiography in Europe, HENRE EU funded project; http://www.unideusto.org/tuningeu/images/stories/Summary_of_outcomes_TN/Tuning_template_for_Radiography_in_Europe.pdf

[5] TUNING Educational Structures in Europe - http://www.unideusto.org/tuningeu/home.html

[6] The European Qualifications Framework - http://ec.europa.eu/education/lifelong-learning-policy/eqf_en.htm

[7] 7. European Higher Education Area – http://www.ehea.info

Core Learning Outcomes

Knowledge, Skills and Competences for Medical Imaging (Diagnostic Radiography), Nuclear Medicine, and Radiotherapy (Radiation Therapy) at entry level

Core Knowledge	Core Skills	Core Competences
facts, principles, theories, practices.	cognitive (use of logical, intuitive and creative thinking) and practical (involving manual dexterity and the use of methods, materials, tools and instruments).	ability to manage complex technical and professional activities, taking responsibility for decision making in unpredictable contexts and for managing own and others professional development.
The radiography graduate in branches of the profession should be able to demonstrate advanced knowledge, involving a critical understanding of theory and the principles of:	The radiography graduate in branches of the profession should be able to demonstrate mastery and innovation and to solve complex and unpredictable problems through skills which show the ability to:	The radiography graduate in branches of the profession who, having followed a course equivalent to EQF level 6, will be required to demonstrate that they are able to display the following competences which will allow them to act as autonomous professionals:
Physics | Radiation Protection | Image Quality		
K1. The biomedical physics underpinning the scientific, effective, safe and efficient use of medical devices used in all aspects of professional practice; K2. X, gamma, particles and positron radiation physics; physical principles of radioactivity; radiation generation, interaction, modification and protection; K3. Radiation hazards, radiation biology, radio sensitivity and dosimetry; K4. Risk: benefit philosophy and principles for both non-ionising and ionising radiation and the whole patient imaging chain; K5. Current national and international radiation protection legislation and regulations relating to staff, patients, carers and the wider general public; K6. Professional roles and responsibilities in terms of all aspects of justification and optimisation; K7. Typical radiation doses from diagnostic and therapeutic procedures; K8. Positioning, immobilisation and beam shielding devices; K9. Physics underpinning non-ionising imaging techniques including magnetic resonance imaging and ultrasound together with associated safety considerations.	S1. Use all appropriate imaging, medical and non-medical devices in an effective, safe and efficient manner; S2. Use effective, safe and efficient radiation protection methods in relation to staff, patients and the general public while applying current safety standards, legislation, guidelines and regulations; S3. Manipulate exposure parameters and variables in order to optimise image quality and radiation dose, as low as reasonably achievable, consistent with diagnostic image quality; S4. Assess patients and their condition in order to effectively justify and then optimise examinations/treatment procedures; S5. Apply safe practices in the use of non-ionising imaging procedures; S6. Apply appropriate procedures to ensure that staff members, patients and general public are protected from radiation hazards.	C1. Take individual responsibility for carrying out work in a safe manner when using both ionising and non-ionising radiation, taking into account current safety standards, guidelines and regulations; C2. Coordinate the process of creating and guaranteeing maximum safety for the patient, oneself and others during examinations /treatments involving ionising radiation and maintain the ALARA principle; C3. Take responsibility with regard to providing advice and in considered circumstances deferring a request or referral which, in his/her evidence based professional opinion, poses a danger to the patient or is inadvisable; C4. Advise on medically significant findings found in images to the appropriate medical personnel responsible for the patient referral.

Core Knowledge	Core Skills	Core Competences
Anatomy, Physiology & Pathology		
K10. Descriptive, cross sectional and topographic-anatomy; K11. Normal human anatomy including its development and change from foetal stages to old age- encompassing normal variations and aberrations; K12. Normal and abnormal physiology in relation to dynamic and physiologically based examinations; K13. Common pathological processes including their appearances on medical imaging examinations; K14. Aetiology, epidemiology, prognosis and staging of the most common tumours; K15. Clinical signs and symptoms related to common pathologies and diseases.	S7. Recognise and describe normal and abnormal anatomical appearances as demonstrated on medical imaging and apply critical thinking in order to assess diagnostic acceptability; S8. Recognise and evaluate normal and abnormal physiology in relation to dynamic and physiologically based examinations; S9. Recognise and describe pathology, disease and trauma processes on medical imaging examinations; S10. Apply anatomical knowledge to imaging techniques during examinations, treatments or interventions conducted by medical specialists.	C5. Develop the ability to retain and further expand knowledge in anatomical, physiological and pathological processes; C6. Be aware of the process leading to making decision on appropriate patient examinations / treatment related to interpretation of clinical information and requests / referrals and prescriptions and give an account of this and advise accordingly; C7. Function in an independent, methodical and evidence based manner. Prepare for and carry out a procedure, process and assess images in terms of quality, carry out a systematic analysis of the images leading to initial interpretation and decision making diagnosis. Complete examination and undertake all required post-examination tasks; C8. Recognise how changes occur as a pathological condition progresses and manage how these changes influences the examination to be carried out.
IT / Risk Management		
K16. Medical equipment and accessories used in professional practice; K17. Information technology found in modern healthcare to include: computer hardware, networks, teleradiology, archiving and storage; K18. Occupational risks, health and safety that may be encountered such as safe moving and handling of patients and equipment , infection control and hospital acquired infections; K19. Basic principles of clinical risk management.	S11. Safely, effectively and efficiently operate medical equipment; S12. Effectively and efficiently use healthcare information technology, data processing, storage, retrieval and manipulation; S13. Apply effective and safe approaches to occupational risks and health and safety; S14. Apply clinical risk management approaches to daily practice.	C9. Develop spatial awareness, attentiveness and manual skills as an ongoing process; C10. Plan and time manage one's own workload and set priorities; C11. Administration and archiving of patient examination and treatment data; C12. Develop individual responsibility for the use of appropriate methods to reduce all risks and hazards which may affect self, patients, staff and the general public; C13. Report of incidents or near miss at an appropriate level; C14. Participate in reactive and/or proactive risk analysis.

Core Knowledge	Core Skills	Core Competences
Numeracy		
K20. Importance of numeracy to practice; K21. Numerical systems.	S15. Understand, manipulate, interpret and present numerical data.	C15. Develop numerical competence for a wide range of professional activities.
Psycho-social patient care		
K22. All aspects of patient care, including parents of paediatric patients and next of kin, to include: • the physical, social, cultural and psychological needs of patients, • ethical decision making with regard to patients, colleagues and the general public; K23. Importance of gaining patient consent and of maintaining patient confidentiality.	S16. Appraise the needs of patients and exercise sound clinical reasoning skills in order to provide appropriate, holistic and context specific care in a broad range of situations within the clinical setting; S17. Ability to monitor and identify vital signs and apply basic life support and emergency procedures when appropriate.	C16. Maintain and manage an optimal balance between the technical, clinical and psychosocial aspects of each examination / treatment, assessing the need for decision making throughout the process; C17. Inform, encourage, advise and support each patient before, during and post examination/ treatment; C18. Maintain a respectful approach to patients and carers; C19. Identify individual patient requirements and provide the necessary patient care and aftercare for the patient; C20. Clinical reasoning based judgements made from verbal and physical presentation of individual patients; C21. Maintain confidentiality in the processing/ handling/archiving of data related to the patient and the procedures carried out while complying with current data protection legislation and regulations.

Core Knowledge	Core Skills	Core Competences
Communication		
K24. Communication theory and practice; K25. Verbal and non verbal communication strategies to be adopted with a wide range of service users, staff and the general public; K26. Behavioural and sociological sciences that influence communication and respect for patients, their carers and other professionals in the healthcare team.	S18. Communicate effectively and efficiently with staff, patients and the general public, use of appropriate professional terminology as required; S19. Formulate and provide information to staff, patients and carers on radiation protection matters and examination, treatment procedures and confirm understanding; S20. Communicate with non experts in the field.	C22. Communicate (verbally and in writing) and participate in a multidisciplinary, multicultural and/or international environment with regard to profession-related issues; C23. Communicate with, advise and instruct other professional groups on profession-related issues and ensure an appropriate chain of care; C24. Instruct, teach and / or mentor staff and students in order to contribute to the development and promotion of their expertise; C25. Furnish third parties with information and education tailored to the target group.
Pharmacology		
K27. All types of drugs (including contrast agents and radiopharmaceuticals) used in professional practice and in emergency resuscitation to include: pharmacology, administration, associated risks, related legislation and regulations; K28. Quality control procedures conducted in association with the radiopharmacy; K29. Safe disposal of chemotherapy/radiopharmaceuticals agents/drugs.	S21. Safely administer contrast agents and other drugs to include cannulation and administration under protocol; S22. Communicate to the patient about the risks of contrast agents and other drugs. S23. Where and when appropriate create radiopharmaceuticals to the standards set out in the relevant legal and policy documents; S24. Able to identify contra-indications in relation to the administration of all types of drugs.	C26. Administer contrast agents and other drugs safely in accordance with established departmental protocols; C27. Respond appropriately to contra-indications, complications and emergencies; C28. Prepare radiopharmaceuticals to the required standard for administration according to the clinical presentation of the patient.

Core Knowledge	Core Skills	Core Competences
Quality Assurance & Innovation		
K30. An effective, safe and efficient service through quality assurance and quality control practices to include: legislation, regulations and guidelines, test equipment and methodologies, programme design and implementation and reporting; K31. Audit of clinical practice in medical imaging and radiotherapy including patient care, standards and diagnostic reference level as applicable.	S25. Performing, recording and analysing quality assurance and quality control activities to include: legislation, regulations and guidelines, test equipment and methodologies, programme design and implementation, and reporting/or action if outside the agreed quality standard; S26. Generate and convey new ideas or generate innovative solutions to known problems and situations.	C29. Be able to, within a multidisciplinary collaborative context; contribute to evaluation, improvement and maintenance of the quality of professional practice; C30. Be able to contribute to the content-related development and profiling of the profession by initiating and implementing quality management and innovation processes; C31. Be able to take note of new developments and apply and implement new protocols to support the safe use of new technologies and procedures; C32. Take individual responsibility for ensuring that quality control / quality assurance of imaging, radiotherapy and medical devices is regularly performed in line with current safety standards, guidelines and regulations.

Core Knowledge	Core Skills	Core Competences
Ethics		
K32. Ethical/moral theories and ethical decision making, including the relationship between ethics and the law and the impact on practice; K33. Inter-professional working relationships within a multi-disciplinary healthcare team in order to ensure the best quality of patient care and the best possible patient outcomes.	S27. Seek appropriate informed consent prior to any examination / treatment to proceeding and establish an effective relationship with the patient; S28. Perform a positive patient identity check, greet and treat each patient with dignity, showing them due respect; S29. Adhere to the professional codes of ethics and conduct including maintenance of patient confidentiality; S30. Act on the basis of a critically reflective attitude taking into account professional codes of ethics, professional behaviour and legal frameworks; S31. Exhibit appropriate professional attitudes and behavior expected from a fully integrated member of the multi-disciplinary healthcare team to ensure the best quality of patient care and the best possible patient outcomes.	C33. Take responsibility for his / her own actions; C34. Recognise the limitations of his / her scope of practice and competence and seek advice and guidance accordingly; C35. Ethically plan and manage workloads and work flow in an effective and efficient manner; C36. Manage the use and consumption of resources and materials ethically; C37. Demonstrate an ethical approach and commitment to patients, carers and staff; C38. Abide with the code of ethics in clinical practice; C39. Exemplify good character within a professional context and maintain these high professional standards in private life; C40. Practice autonomously and as part of a team within a work organisation; C41. Make an appropriate and argued contribution, Whenever possible, within a multidisciplinary team; C42. Contribute to an effective interdisciplinary, multicultural and / or international collaboration and chain of care, Whenever possible; C43. Undertake clinical work within your own professional scope of practice as part of the multidisciplinary team; C44. Apply and follow instructions and/or directives from one's own or other departments into practice; C45. Whenever possible contribute to team development and conflict resolution.

Core Knowledge	Core Skills	Core Competences
Research and Audit		
K34. Audit, research and evidence based practice including: the stages in the research process, research ethics and analysis to facilitate a deeper understanding of research findings and clinical audit.	S32. Use appropriate databases to undertake literature searches and critically appraise published works; S33. Collect and use the data from processes as part of an audit cycle; S34. Utilise, interpret, evaluate and analyse all collected data from appropriate research processes adding to the evidence-base; S35. Critically appraise published literature; S36. Identify the principles of evidence-based practice and the research process; S37. Use statistical skills in order to understand and analyse data.	C46. Apply available relevant national and international scientific insights, theories, concepts and research results to issues in their professional practice; C47. Use and integrate relevant national and international scientific insights, theories, concepts and research results in one's own professional actions especially when taking decisions about patient care; C48. Carry out and contribute to research and/or clinical audit, either independently or in collaboration with colleagues, to improve the quality of care for further development of professional practice; C49. Disseminate results of clinical audit and research.
Professional Aspects		
K35. Major reference points of the broad context of Medical Imaging / Radiotherapy / Nuclear medicine and knowledge of how to interrelate theory and practice constructively; K36. The history and current status of the profession both nationally and internationally; K37. Be in possession to inform and educate the general public about the risks and benefits of medical imaging examinations / radiation therapy treatments / nuclear medicine procedures as part of informed consent, so that they can make an informed decision, guided by national and international knowledge.	S38. Critically reflect on and evaluate his/her own experience and practice; S39. Plan and organise professional activity and recognise the value of managing change and establishing opportunities for professional development; S40. Work efficiently and effectively in order to provide high quality patient focused services within established timeframes; S41. Demonstrate practitioner level leadership, management and team working skills; S42. Educate other health care professionals and the general public to understand the risks and benefits of the application of radiation across imaging and treatment.	C50. Ability to adapt new developments or innovations relating to profession-related issues in a national or international context; C51. Contribute to the content-related development and profiling of the profession by initiating and implementing quality management and innovation processes; C52. Within a multidisciplinary collaborative context, contribute to evaluation, improvement and maintenance of the quality of professional practice; C53. Constantly update knowledge to be able to implement current guidelines in professional practice; C54. To reflect on and learn from research evidence and experience, and apply to own and others working practice.

Core Knowledge	Core Skills	Core Competences
Personal and Professional Development		
K38. The importance of developing and reflecting on professional activity-including the reflective process; K39. The importance of maintaining competence and confidence through the activity of continued professional development (CPD) in order to continually deliver high standards of care to patients; K40. National legal and professional requirements for CPD.	S43. Recognise the need for CPD and Life Long Learning (LLL); S44. Ability to audit ones own skills and set objectives through the evaluation of one's own actions through self reflection; S45. Explain the risks and benefits of ionising radiation so that patient and or legal guardian can make an informed decision.	C55. Be a reflective practitioner and work autonomously; C56. Play an active role in promoting one's own professional awareness and in developing one's competences; C57. Manage one's own professional career; C58. Support the development of team practice though sharing ideas, giving and receiving constructive feedback.

Specific learning outcomes for Medical Imaging (Diagnostic Radiography) at entry level

In addition to the core learning outcomes, the diagnostic radiographer should be able to demonstrate the following knowledge, skills and competence:

Knowledge	Skills	Competence
Medical Imaging / Diagnostic Radiography		
The medical imaging / diagnostic radiographer should be able to demonstrate advanced knowledge, involving critical understanding of theory and the principles of:	The medical imaging / diagnostic radiographer should be able to demonstrate mastery and innovation of skills through the ability to:	The medical imaging / diagnostic radiography is to display the following competences:
K1. The scientific basis of the range of medical imaging techniques across the range of technology / equipment used; K2. Technical appraisal of all diagnostic images produced to facilitate judgements to be made in relation to diagnostic acceptability and quality; K3. Mechanisms of causation of injuries; K4. Pathology and disease and trauma processes along with their appearance on medical imaging examinations so that an initial interpretation can be made in order to facilitate diagnostic decision making related to optimising medical imaging examinations; K5. Image processing techniques applied in the modern medical imaging environment; K6. Specialist image examinations and interventions; K7. Medical emergencies requiring imaging.	S1. Evaluate and identify the most appropriate imaging examination to be carried out on the basis of analysis of the clinical information provided and the patient presentation; S2. Undertake effective and efficient appraisal of all diagnostic images produced to facilitate judgements to be made in relation to diagnostic acceptability and quality; S3. Apply critical thinking in order to facilitate diagnostic decision making related to optimising medical imaging examinations; S4. Generate and manipulate images (including verification of exposure factors) effectively and appropriately in relation to the pathology or trauma to be demonstrated; S5. Efficiently perform image processing techniques.	C1. Apply critical thought in a methodical and evidence based manner to prepare for and perform a diagnostic procedure, process the resulting images and appraise the images in terms of quality and diagnostic acceptability to enable decision, complete the examination and undertake all required post-examination tasks for all medical imaging examinations (to include cannulation and contrast administration under protocol); C2. Evaluate images produced, making judgements about the acceptability of the quality of the images in the context of the patient's condition. This includes assessing images to understand the potential need to undertake further imaging procedures or additional projections/ procedures and the need to make judgements about the absence or presence and possible nature of trauma or pathology demonstrated; C3. Take responsibility for keeping abreast of developments in the field of imaging.

Specific learning outcomes for Nuclear Medicine at entry level

In addition to the core learning outcomes, the nuclear medicine radiographer / technologist should be able to demonstrate the following knowledge, skills and competences

Knowledge	Skills	Competence
Nuclear Medicine		
The nuclear medicine radiographer / technologists should be able to demonstrate advanced knowledge, involving critical understanding of theory and the principles and the understanding of:	The nuclear medicine radiographer / technologist should be able to demonstrate mastery and innovation of skills through the ability to:	The nuclear medicine radiographer / technologists is to display the following competences:
K1. The construction and mechanism of operation of CT and MRI Hybrid scanners; K2. The effect of CT and MRI acquisition parameters on image quality and patient dose.	S1. Determine whether routine CT QC tests fall within manufacturer specifications; similarly determine whether PET-CT and SPECT-CT QC tests meet manufacturer specification; S2. Operate a CT and MRI scanner; manipulate acquisition parameters that determine dose and image quality.	C1. Perform routine CT QC tests; perform SPECT-CT and PET-CT QC tests; C2. Perform a CT scan for the attenuation of correction of PET and SPECT data; C3. Under a detailed protocol, perform CT imaging that is commonly conducted as part of a hybrid PET-CT or SPECT-CT investigation; C4. Under a detailed protocol reconstruct and display the CT images alongside / fused to the PET and / or SPECT images.

Specific learning outcomes for Radiotherapy (Radiation Therapy) at entry level

In addition to the core learning outcomes, the Radiotherapy Radiographer / Radiation Therapist should be able to demonstrate the following knowledge, skills and competence

Knowledge	Skills	Competence
Radiotherapy / Radiation Therapy		
The Radiotherapy Radiographer / Radiation Therapist should be able to demonstrate advanced knowledge, involving critical understanding of theory and the principles of:	The Radiotherapy Radiographer / Radiation Therapist should be able to demonstrate mastery and innovation of skills through the ability to:	The Radiotherapy Radiographer / Radiation Therapist is to display the following competences:
K1. The scientific principle of the differential cell killing ability of ionising radiation as the basis upon which the practice of radiotherapy is founded; K2. Radiobiology underpinning radiation and cytotoxic therapy treatments; hormone therapy, immunotherapy and molecular radiotherapy for cancer and benign conditions; K3. Treatment planning fundamentals: • Prescribing, recording and reporting photon beam therapy, particle beam therapy including the concepts of target volumes and their margins described by the International Commission on Radiation Units & Measurements; • The influence of tissue inhomogeneities and how to modify the dose distribution to optimise the treatment plan; • Meaning of dose constraints to normal tissue and principles of usage in treatment planning; • Distinction between palliative, curative and adjuvant RT, including their implications on choice of treatment technique and dose level; K4. Principles of patient positioning and immobilisation according to treatment site; K5. Equipment for treatment planning and planning techniques; K6. Radiation information and radiotherapy verification systems.	S1. Producing and appraising an appropriate treatment plan that meets the requirements of thet-reatment prescription; S2. Carrying out and evaluating an external beam / brachytherapy treatment delivery that meets the requirements of the treatment prescription; S3. Identify the appropriate management of a range of tumours; S4. Recognition of Organs at Risk on medical images for tumour localisation and treatment planning, including normal tissue as well as tumour response; S5. Assessment of a radiation response that requires a course of treatment to be interrupted; S6. Effective, safe and efficient use of radiation therapy verification and information systems for localisation and verification; S7. Assessment of the patient condition/identification of limitations of treatment equipment/ devices during planning to ensure the planned treatment can be reproduced and delivered on the treatment equipment.	C1. Able to define treatment cycles in terms of time, taking into account priorities, available-staff and material possibilities; C2. Numerical competence in mathematical processes and radiobiological processes involved in radiation dose calculations and distribution; C3. Collaborate with external agencies in the provision of continual care for patients with cancer across their specific cancer treatment pathway; C4. Participation in the implementation of local, national or international clinical trials into the department; C5. Interpret the radiation prescription and treatment plan in such a way that procedures relevant to the defined area of practice are implemented safely and accurately under protocol.

Knowledge	Skills	Competence
K7. Fundamental principles of treatment simulation treatment delivery - including external beams, brachytherapy, unsealed source therapies; K8. Radiotherapy techniques such as stereotactic RT, IMRT, IGRT [off-line, on-line], and Adaptive Radiotherapy; K9. Oncology including the development of cancers and the characteristic of cancer cells and the management of cancer including TNM classification and other commonly used cancer staging systems; K10. Technical appraisal of diagnostic radiotherapy planning images for tumour localisation and treatment planning and verification using appropriate imaging modalities; K11. Side effects of radiotherapy treatments and their management; the factors affecting the severity of side effects, toxicities and management; K12. Understanding the impact of tissue inhomogeneity, wedges, weight factors, beam shape and properties upon dose distribution; K13. Principles of the use of radiotherapy in the treatment of non-malignant conditions.	S8. Educate and inform the patient about the whole treatment process and preparation requirements for treatment including motion management and ongoing care; S9. Inform patients of any possible side effects from their specific radiotherapy treatment and how to manage these side effects in collaboration with the multidisciplinary team; S10. Accurate patient set-up and delivery of treatment including monitoring and verification.	C6. Generate simple radiation dose delivery calculations dosimetric planning relevant to their defined area of practice; C7. Effectively operate radiotherapy and relevant imaging and dose monitoring equipment in their defined area of practice to ensure safety and accuracy; C8. Select, plan, implement, manage and evaluate pre-treatment, treatment, on treatment (offline, on-line real time image review) and post-treatment procedures and care safely and accurately and in such a way that they take account of individuals' health status, environment and needs.

APPENDICES

Appendix 1 - MEDRAPET Report 2013

MEDRAPET
Medical Radiation Protection
EDUCATION AND TRAINING

Chapter 6. Learning outcomes for radiographers EC RP175

In a modern health service the roles and tasks performed by radiographers are many and varied. In order to address this and to avoid confusion created by different professional and national titles a definition of a radiographer was developed and approved by the EFRS General Assembly in 2010 [1].

Within the scope of this document the term "Radiographer" will therefore be used to refer to professional roles in the fields of diagnostic imaging, NM, IR and radiation therapy.

Radiographers [1]:

- are the health care professionals responsible to perform safe and accurate procedures, using a wide range of sophisticated technology in medical imaging and/or radiotherapy and/or NM and/or IR;
- are professionally accountable for the patients' physical and psychosocial well-being, prior to, during and following diagnostic and radiotherapy procedures;
- take an active role in justification and optimisation of medical imaging and radio therapeutic procedures;
- are key-persons in radiation safety of patients and other persons in accordance with the ALARA principle and relevant legislation.

In NM, the title NM Technologists (NMT) is recognised by EANM and IAEA. NMTs perform highly specialised work alongside other healthcare professionals to fulfil responsible roles in patient care and management and radiation protection in diagnostic and therapeutic procedures. They have non-imaging roles within the radio pharmacy and laboratory and also have involvement with PET/CT aided radiation therapy planning [2].

In Radiation Oncology practices, other than Therapeutic NM practices, the title Radiation TherapisTs (RTTs) is recognised in the core curriculum published by ESTRO [3] and the IAEA. RTTs are the professionals with direct responsibility for the daily administration of radiotherapy to cancer patients. This encompasses the safe and accurate delivery of the radiation dose prescribed, the clinical and the supportive care of the patient on a daily basis throughout the treatment preparation, treatment and immediate post treatment phases [4].

It is essential whilst carrying out clinical practice in diagnostic and therapy procedures, that radiographers use current knowledge in order to secure, maintain or improve the health and well-being of the patient [5].

While performing their role radiographers also have responsibilities for radiation protection, patient care and QA during medical imaging or radio therapeutic procedures.

Radiographers act as the interface between patient and technology in medical imaging and radiation therapy. They are the gatekeepers of patient and staff radiological protection, having a key-role in optimization at the time of exposure to radiation [6].

Radiographers' work in a diverse range of areas and each area demands its own specific KSC. The areas include: radionuclide production which involves cyclotrons and generators; radio-labelling of compounds and living structures (e.g. cells); diagnostic imaging (e.g. X-ray, PET, and NM); radiotherapy (teletherapy, brachytherapy and unsealed source radionuclide therapy); Imaging arising from therapy procedures (e.g. IMRT).

The radiation protection learning outcomes for radiographers provides a set of core learning outcomes together with specific sets of learning outcomes pertinent to diagnostic radiography, NM and radiation therapy [2], [3], [7], [10].

6.1. Radiation protection professional entry requirements

According to the Tuning Template for Radiography, developed under the EU project HENRE (Higher Education Network for Radiography in Europe) [7], the professional entry requirements for Radiographers should be equivalent to level 6 of the EQF [8]. Radiation protection is a major subject for Radiographers and should be at the same level as their professional entry-level requirements of the EQF.

6.2. Continuous professional development in radiation protection

Through their careers Radiographers advance to level 7 of the EQF and in some cases even higher, especially for sophisticated diagnostic and therapeutic radiological procedures and this should be through CPD activities that enhance their KSC to higher levels [9]. Special emphasis should be given to new diagnostic and therapeutic systems and the acquisition of skills in the practical use of such systems.

References

[1] EFRS, 2011. Definition of a Radiographer and recommendations for the use of the professional name in Europe. EFRS, Utrecht, The Netherlands. http://www.efrs.eu/the-profession/(Last time accessed was on the 24th of March 2013)

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Table 6.1 - Specific learning outcomes for Radiation Protection at entry level

Knowledge (facts, principles, theories, practices)	Skills (cognitive and practical)	Competence (responsibility and autonomy)
Core Learning outcomes in radiation protection		
K1. Explain physical principles of radiation generation, interaction, modification and protection;	S1. Use the appropriate medical devices in an effective, safe and efficient manner;	C1. Practise effectively, accurately and safely and within the guidance of legal, ethical and professional frameworks;
K2. Explain radiation physics, radiation hazards, radiation biology and dosimetry;	S2. Use effective, safe and efficient radiation protection methods in relation to staff, patients and the general public applying current safety standards, legislation, guidelines and regulations;	C2. Use appropriate and correct identification, address and treatment of the patient (and any accompanying carer if appropriate);
K3. Understand risk: benefit philosophy and principles involved in all aspects of radiography;	S3. Critically review the justification of a given procedure and verify it in the light of appropriateness guidelines and in case of doubt consult the responsible specialist;	C3. Avoid unnecessary exposures and minimise necessary exposures as part of optimisation;
K4. Identify current national and international radiation protection legislation and regulations relating to staff, patients, carers and the wider general public;	S4. Use and undertake clinical audits;	C4. Seek consent for any examination/treatment to proceed;
K5. Explain physics underpinning non-ionising imaging techniques including magnetic resonance imaging and ultrasound along with associated safety considerations;	S5. Identify the principles of evidence-based practice and the research process;	C5. Carry out work in a safe manner when using ionising radiation, taking into account current safety standards, guidelines and regulations;
K6. Describe professional roles and responsibilities in terms of aspects of justification and optimisation;	S6. Critically reflect on and evaluate his/her own experience and practice;	C6. Participate in the process of creating and guaranteeing maximum safety for the patient, oneself and others during examinations /treatments involving ionising radiation and maintain the ALARA principle;
K7. Explain QA and QC practices to include: legislation, regulations and guidelines, test equipment and methodologies, programme design and implementation and reporting to thus ensure the provision of an effective, safe and efficient service;	S7. Participate in CPD;	C7. Refuse to accept or carry out a request or referral which, in his/her professional opinion, is dangerous or inadvisable;
K8. Understand occupational risks, health and safety that may be encountered such as safe moving and handling of patients and equipment;	S8. Recognize the complicated situation pertaining to radiation protection regarding scientific knowledge on the one side and societal concern and personal emotions on the other side;	C8. Recognise the limitations to his/her scope of competence and seek advice and guidance accordingly;
K9. Describe the importance of audit, research and evidence-based practice to include: the stages in the research process, research governance, ethics, statistics and statistical analysis to facilitate a deeper understanding of research findings and clinical audit;	S9. Identify different image quality standards for different techniques;	C9. When taking decisions about care for (individual) patients be able to make use of relevant national and international (scientific) insights, theories, concepts and research results and integrates these approaches in one's own professional actions (evidence-based practice).
K10. Identify the different determinants of radiation risk perception; know the pit-falls of communication on radiation risks.	S10. Apply the concepts and tools for radiation protection optimisation.	

Knowledge (facts, principles, theories, practices)	Skills (cognitive and practical)	Competence (responsibility and autonomy)
K11. Understand the particular protection aspects of pregnant women (includes pregnant radiographer/ employee), carers and children and knows how to take care of these persons; K12. Describe the risk to pregnant women and foetus involved in radiotherapy, NM, and diagnostic and IR; K13. Explain dose, quantities and units and their relevance to own professional practice; K14. Explain the management of accidental/unintended exposures; K15. Explain the concepts and tools for RP optimisation.		C10. Recognize the radiation hazards associated with their work and take measures to minimize them; C11. Monitor their radiation exposures with the use of a personal dosimeter; C12. Establish safe working conditions according to the recommendations and the statutory requirements of European, national, regional legislation, where applicable; C13. Instruct other personnel participating in matters relating to appropriate RP practices; C14. Carry out short-term and practice-oriented research or clinical audit, either independently or in collaboration with colleagues, to improve the quality of care; C15. Participate in clinical audit and applied research for the further development of professional practice and its scientific foundation; C16. Place radiation risks in relation to other risks within a societal context; C17. Reflects on their own radiation risk perception; C18. Evaluate the results of routine QA tests.

Table 6.1.1 - Additional learning outcomes in radiation protection for diagnostic radiographers

Knowledge (facts, principles, theories, practices)	Skills (cognitive and practical)	Competence (responsibility and autonomy)
Additional for Medical Imaging		
K1. Explain the relationship of exposure factors to patient exposure; K2. Understand how patient position affects image quality and dose to radiosensitive organs; K3. Understand the effect of filter type in diagnostic x ray systems; K4. Understand the purpose and importance of patient shielding; K5. Understand post-processing possibilities for CR and DR systems (filters, noise, magnification, raw data manipulation); K6. Know recommendations and legal requirements applying to medical, occupational, and public exposure.	S1. Performs the medical procedure with the appropriate X-ray equipment suited and optimized for the specific medical procedure (adult, paediatric, projection possibilities, adjustments for longer procedure time, etc.); S2. Operates according to Good Medical Practice in order to minimize overall fluoroscopy time; S3. Puts into practice the basic principles of preventing (unnecessary) exposure (time, distance, shielding); S4. Program the use of beam filters in mammography and conventional radiography (proper use of additional filtration); S5. Use and record the integrated dose meter (DAP) and checks the measured values against DRLs and/or threshold doses for deterministic effect in order to prevent deleterious effects on patients whenever possible; S6. Identify various types of patient shielding and state the advantages and disadvantages of each type; S7. Use the appropriate method of shielding for a given radiographic procedure; S8. Identify difference between continuous and pulsed fluoroscopy and use each mode when appropriate; S9. Explain and communicate effectively the nature and magnitude of radiation risk and benefits, in order to obtain informed consent.	C1. Take responsibility for use of proper exposition parameters according to type of modality and to radiological procedure; C2. Identify the appropriate image receptor that will result in an optimum diagnostic image with the minimum radiation exposure to the patient; C3. Identify proper C-arm position regarding occupational doses; C4. Discuss added and inherent filtration in terms of the effect on patient exposure; C5. Compares dose measurements (DAP, DLP, KAP, ESD, CTDI, glandular dose) readings or equivalent to National or European DRLs; C6. Participate in the optimization of all parameters to create protocols regarding to National or European DRL; C7. Optimize radiological procedure to fit for pregnant women and use appropriate paediatric protocols; C8. Take responsibility of choosing post processing tools and change exposure parameters to obtain lower dose for clinical diagnostic images; C9. Advise proper use of personal protection; C10. Optimise the use of radiology equipment according to ALARA principles.

Table 6.1.2 - Additional learning outcomes in radiation protection for nuclear medicine radiographers

Knowledge (facts, principles, theories, practices)	Skills (cognitive and practical)	Competence (responsibility and autonomy)
Additional for nuclear medicine		
K1. Explain the physical principles of radionuclides' production; K2. Explain how radionuclides can be physically shielded; K3. Explain the biological basis on which pharmacodynamics and pharmacokinteics occur for the range of therapeutic and diagnostic procedures; K4. Understand the risk-benefit of NM procedures; K5. State which QC tests should be applied to which pieces of NM equipment, why, how and their frequency; K6. Explain the legal and clinical basis on which NM procedures, both diagnostic and therapeutic, are requested and justified; K7. Identify which non-ionizing radiation diagnostic examinations can be used as possible alternatives to NM procedures; K8. Explain how pediatric doses can be calculated; K9. Indicate which diagnostic examinations carry radiation risk to breast feeding babies; indicate the contingencies which might apply; K10. For diagnostic procedures, explain what practical steps can be taken to minimise radiation risk to radiosensitive organs (e.g. thyroid gland); K11. Understand interactions, pharmacology and adverse reactions of drugs commonly encountered within NM with a particular emphasis on radiopharmaceuticals and x-ray contrast agents; K12. Understand biological and physical half-lives of the radiopharmaceuticals used for diagnostic and therapeutic procedures.	S1. Acquire and process images and data that have clinical relevance within NM, observing the principles of exposure optimisation and dose management (e.g. PET/CT); S2. Use devices which can be used to monitor and also minimise radiation dose; S3. Use all relevant laboratory equipment; S4. Translate guidance and local rules into practical working routines so as to minimise dose to staff, patients and the public; S5. Be able to work very fast when handling radionuclides but not at the expense of incurring an adverse incident; S6. Be able to communicate effectively with patients and carers so that diagnostic examination requirements are met but not at the expense of compromising the patient experience; S7. Be able to discuss with the medical referrer on whether the requested NM procedure is appropriate in part or in whole; S8. Be aware of the fact that a patient after a radioactive injection is to be separated from other patients; S9. Be able to prepare, manipulate and administer radioisotopes, to patients, assuring prior, per and post administration radioprotection measures; S10. Perform laboratory tests (e.g. GFR).	C1. Take responsibility for conforming to national regulations for all handling of unsealed radioactive substances; C2. Take responsibility for conforming to local standards and standard SOPs while handling unsealed radioactive substances; C3. Take responsibility for handling unsealed radioactive substances in a manner that accidental / unintended exposure of oneself as well as co-workers is avoided; C4. Comply with good manufacturing practice when working within the radiopharmacy; C5. Take responsibility for interpreting QC tests to determine whether NM equipment is within manufacturer specification; C6. C6. Take responsibility for drawing up the correct quantity of radiopharmaceutical for administration, taking into account DRLs; C7. C7. Working within a devolved framework, justify the diagnostic NM procedure; C8. C8. Take responsibility for obtaining patients' consent for diagnostic procedures; for explaining procedures to the patient and responding appropriately to their questions.

Knowledge (facts, principles, theories, practices)	Skills (cognitive and practical)	Competence (responsibility and autonomy)
K13. Outline how developments in imaging technology can be used to minimise dose, and therefore risk, from diagnostic NM procedures; K14. Outline the role of the physicist and physician in relation to adverse radiation incidents (e.g. administration of a dose to the wrong patient); K15. Outline the role of the physicist in minimising dose to the environment and humans; K16. Explain the radiation protection principles, legal requirements and practical solutions which can be used to enhance safe storage, handling and disposal of radioactive materials used within NM; K17. State the range of additional radiation protection requirements imposed for patients who are to undergo NM therapy procedures; K18. For the radio-labelling of human products (e.g. white cells) explain how good manufacturing practice principles can be applied to minimise the incidence of radiation accidents; K19. State how time, distance, shielding, monitoring and audit can be used to minimise dose received by staff, patients and public; K20. With good practice in mind, explain how a radiation contamination spill should be dealt with; K21. Explain how dose to pregnant females can be minimised when a diagnostic NM procedure must be undertaken; K22. Explain how a radionuclide dose should be administered in order to eliminate residual radiation such as, in a syringe; K23. For hybrid procedures involving x-ray CT explain the practical measures that should be undertaken to minimise dose to staff, patient and members of the public; K24. Explain the mechanism of DNA damage due to ionising radiation; K25. Describe the cellular effects of radiation and, mechanisms of cell death.	S11. Perform and interpret QC tests to determine whether NM equipment is within manufacturer specification; S12. Calculate and draw up the correct quantity of radiopharmaceutical required for administration; S13. Consent patients for diagnostic procedures; explain procedures to the patient and respond appropriately to questions; S14. Administer radiopharmaceuticals that are used for diagnostic procedures; S15. Assist the physician with the administration of radiopharmaceuticals used for therapeutic procedures; S16. Offer appropriate radiation protection advice to patients undergoing diagnostic NM procedures; S17. Care for patients who require a high level of care whilst at the same time minimising personal radiation dose; S18. Organise clinical workflow so that radioactive patients have minimal contact with at risk individuals (e.g. pregnant females); S19. Decontaminate radioactive spills in a safe and efficient manner.	C9. Take responsibility for the administration of radiopharmaceuticals which are used for diagnostic procedures; C10. Take responsibility for appropriate radiation protection advice to patients undergoing diagnostic NM procedures; C11. Take responsibility for providing appropriate care for patients whilst at the same time minimising personal radiation dose; C12. Take responsibility for performing the diagnostic procedure to a suitable standard, ensuring that no repeat examination is required because of technical deficiency; C13. Supervise the clinical workflow such that exposure of risk individuals (eg pregnant females) from other patients is minimised; C14. Take responsibility for dealing with radiation contamination in a safe and efficient manner.

Table 6.1.3 - Additional learning outcomes in radiation protection for for radiotherapy radiographers

Knowledge (facts, principles, theories, practices)	Skills (cognitive and practical)	Competence (responsibility and autonomy)
Additional for Radiotherapy		
K1. Understand biomedical physics underpinning the scientific, effective, safe and efficient use of medical devices used in radiation therapy, including medical imaging devices used for tumour localisation and treatment planning; K2. Knowledge and understanding of the radiation physics underpinning radiation therapy treatments and medical imaging examinations for tumour localisation and treatment planning to include: nuclear structure, radioactive decay, interaction with matter, electromagnetic radiation, particle radiation, sources of radiation, tissue in homogeneity, wedges, weigh factors, beam shape and properties; K3. Knowledge and understanding of radiation protection underpinning radiation therapy treatments and medical imaging examinations for tumour localisation and treatment planning to include: radiation hazards, radiation shielding, detection methods, current national and international radiation protection legislation and regulations relating to staff, patients and the general public; K4. Knowledge and understanding of the radiobiology underpinning radiation and cytotoxic therapy treatments, and medical imaging examinations for tumour localisation and treatment planning to include: cell biology, effects of ionising and non-ionising radiation, radiation risks, radio sensitivity, side effects of radiation therapy treatments; K5. Explain DNA damage; K6. Describe the cellular effects, mechanisms of cell death; K7. Explain the cell survival curves; K8. Describe the normal tissue, solid tumour and leukaemia systems; K9. Explain the effects of oxygen, sensitizers and protectors; K10. Explain the effect of time-dose-fractionation, LET and different radiation modalities and interaction between cytotoxic therapy and radiation;	S1. Use medical devices in radiation therapy, including medical imaging devices, used for tumour localisation and treatment planning in a safe and effective manner; S2. Analyse the properties of particle and electromagnetic radiation; S3. Apply treatment planning including 3D planning, virtual and CT simulation and applies these procedures to plan patients' treatments; S4. Prepare treatment plans using IMRT and other techniques such as stereotactic, particle and IGRT; S5. Define the target and OAR using ICRU terminology; S6. Describe how DVHs are created and used to evaluate plans; S7. Relate the influence of changing planning parameters on DVHs; S8. Use radiation protection methods relating to staff, patients and the general public, taking into account current safety standards, guidelines and regulations; S9. Justify and optimise all procedures effectively; S10. Recognize OAR on medical images for tumour localisation and treatment planning;	C1. Able to take into account, from the perspective of the patient, the technical, clinical and treatment while it is being conducted; C2. Able to select and argue a suitable treatment on the basis of (one's own) analysis of a question and/or indication, give an account of this and advise accordingly; C3. Work in an independent, methodical and evidence-based manner in terms of quality, complete the treatment and report accordingly; C4. Able to work in a safe manner when carrying out treatments with ionizing radiation, taking into account current safety standards, guidelines and regulations; C5. Critically evaluate the dose distribution and DVHs; C6. Optimise and evaluate the plan options C7. Assess the daily physical and psychological status of the; C8. Record all side effects and advise the patient on their management in accordance with department protocol; C9. Calculate/check monitor units and treatment times;

Knowledge (facts, principles, theories, practices)	Skills (cognitive and practical)	Competence (responsibility and autonomy)
K11. Knowledge and understanding of Digital Reconstructed Radiograph (DRR);	S11. Recognise the signs and symptoms associated with treatment in different sites;	C10. Check treatment prescription calculations for accuracy and alert clinician of any discrepancies;
K12. Knowledge and understanding of Beams Eye View (BEV);	S12. Identify the side effects associated with the individual treatment;	C11. Check decay tables/exposure rates for Cobalt units are updated;
K13. Knowledge and understanding of Gross Target Volume (GTV), Clinical Target Volume (CTV) and Planning Target Volume (PTV);	S13. Define the effects of concomitant treatment;	C12. Apply safety procedures when using brachytherapy sources;
K14. Knowledge and understanding of Organs at Risk (OAR);	S14. Analyse stochastic and deterministic effects;	C13. Assess patients undergoing external beam radiotherapy and brachytherapy and refer to the radiation oncologist or other health professional as appropriate;
K15. Knowledge and understanding of Dose Volume Histograms (DVH);	S15. Define the parameters routinely used;	C14. Assess the practical problems associated with machine and accessory equipment limitations and respond accordingly;
K16. Explain the collimating systems;	S16. Recognise the critical structures on the verification images;	C15. Optimise and evaluate plan options;
K17. Describe Brachytherapy systems;	S17. Identify the imaging protocol;	C16. Carry out manual calculations;
K18. Explain absorbed dose;	S18. Identify the daily entrance and exit dose and dose level of critical organs;	C17. Engage in QA and follow safety policies;
K19. Define target absorbed dose specification in external RT;	S19. Be familiar with reporting system and reporting protocols;	C18. Check if all parameters, devices and settings are correct;
K20. Define target absorbed dose specification in brachytherapy;	S20. Describe the radiation hazards and how they are managed;	C19. Carry out in vivo dosimetry;
K21. Illustrate algorithms for 3D dose calculations;	S21. Effective, safe and efficient use of positioning, immobilisation and beam shielding devices used in radiation therapy;	C20. Evaluate results, take corrective action as per protocol and report any inconsistency;
K22. Explain applications of conformal RT, IMRT, IGRT, stereotactic RT and particle therapy;	S22. Use radiation therapy verification systems safely, effectively and efficiently;	C21. Analyse and record the results and report any deviations;
K23. Describe radiation weighting factor;	S23. Perform, record and analyse QC activities;	C22. Report incidents and near incidents to the multidisciplinary team.
K24. Explain the risk of induction of secondary tumours;	S24. Approach occupational risks, health and safety such as safe moving and handling of patients and equipment in a safe and effective manner.	C23. Examine any incident or near incidents and how they can be prevented in the future;
K25. Explain equivalent dose – tissue weighting factor;		C24. Routinely inspect the area to ensure that radiation protection measures are in place and functional.
K26. Knowledge and understanding of the scientific basis of the range of radiation therapy techniques and medical imaging techniques for tumour localisation and treatment planning across the range of technology / equipment used along with the operational and maintenance, for professional purposes, so that equipment can be operated at the highest level of understanding;		
K27. Knowledge and understanding of positioning, immobilisation and beam shielding devices used in radiation therapy;		
K28. Knowledge and understanding of radiation therapy verification systems;		
K29. Knowledge and understanding related to the technical appraisal of diagnostic images for tumour localisation and treatment planning produced, to facilitate judgements to be made in relation to acceptability and quality.		

Appendix 2 - EFRS definition of a Radiographer and recommendations for the use of the professional name in Europe

Radiographers are medical imaging and radiotherapy experts who:

- are professionally accountable to the patients' physical and psychosocial well-being, prior to, during and following examinations or therapy;
- take an active role in justification and optimisation of medical imaging and radio therapeutic procedures
- are key-persons in radiation safety of patients and third persons in accordance with the "As Low As Reasonably Achievable (ALARA)" principle and relevant legislation

DIAGNOSTIC radiographers (Medical Imaging)

are responsible for the preparation and performance of safe and accurate imaging examinations and post processing, using a wide range of sophisticated X-ray equipment and techniques.

In many European countries these techniques also include the use of:

- high frequency sound = Ultrasound
- strong magnetic fields = Magnetic Resonance Imaging (MRI)
- radioactive tracers = Nuclear Medicine

RADIOTHERAPY radiographers

are responsible for the preparation and performance of safe and accurate high-energy radiation treatments, using a wide range of sophisticated irradiation and imaging equipment and techniques, this includes:

- optimising the patient position and production of individual immobilisation as required
- using simulation to collect data/ information to identify the target volume and organs at risk using appropriate imaging modalities
- treatment planning to achieve an optimal dose distribution in the target volume and organs at risk
- verification of the treatment plan, patient set-up and daily verification of patient positioning
- irradiation of the target volume

EFRS Recommendation for the use of the professional name

Because of the wide variety of national titles in Europe that are used to indicate the same professional group the EFRS General Assembly has decided to refer to the profession in the EFRS documents with the single name of RADIOGRAPHER.

The EFRS recommends European official bodies and authorities to use this single title in all their documents and correspondence at the European level, while referring to the list with national titles on page 30.

List of National titles for radiographers in EFRS member countries

(updated from EFRS member survey 2012)

	Medical Imaging	Radiotherapy	Nuclear Medicine
Austria	Radiologietechnologin / Radiologietechnologe		
Belgium	Technoloog in de Medische Beeldvorming Technologue en imagerie médicale	RT is not a recognised profession in Belgium	Technoloog in de Medische Beeldvorming Technologue en imagerie médicale
Bosnia & Herzegovina	Diplomirani inzinjer medicinske radiologije		
Croatia	Medical Radiology Engineer		
Cyprus	Technologos Aktinologos	Technologos Aktinotherapeutis	Technologos Aktinologos
Czech Rep.	Radiologicky asistent		
Denmark	Radiograf		
Estonia	radioloogiatehnik or radioloogiaõde		
Finland	Röntgenhoitaja		
France	Manipulateur d'electroradiologie medicale		
Germany	Medizinisch-technische Radiologieassistent(in)		
Greece	Technologos Aktinologos	Technologos Aktinotherapias	Technologos Pirinikis Iatrikis
Hungary	Radiográfus, Diagnosztikai képalkotó, Röntgenasszisztnes, Képi diagnosztikai és intervenciós szakasszisztens	Radiográfus	
Iceland	Geislafrćðingur		
Italy	Tecnico sanitario di radiologia medica		
Ireland	Radiographer	Radiation therapist	Radiographer
Latvia	Radiologa asistents		
Lithuania	Radiologijos technologas		
Luxembourg	Assistant Technique Médicale		
Macedonia (Fyrom)	Radioloski tehnolog		
Malta	Radiographer		
Netherlands	Medisch Beeldvormings- en Bestralingsdeskundige (MBB)		
	Radiodiagnostisch laborant	Radiotherapeutisch laborant	Medisch Nucleair werker
Norway	Radiograf	Strĺleterapeut	Radiograf
Poland	Elektroradiolog, technik elektroradiologii		
Portugal	Técnico de radiologia	Técnico de radioterapia	Técnico de medicina nuclear
Serbia	Strukovni medicinski radiolog/ radioloski tehnicar	Visi radioloski tehnicar	Tehničara nuklearne medicine
Slovakia	Rádiologický technik		
Slovenia	Diplomirani radioloski inženir		
Spain	Tecnico espcialista de radiodiagnostico	Tecnico espcialista de radiotherapia	
Sweden	Legitimerad Röntgensjuksköterska	Legitimerad sjuksköterska med specialsistsjuksköterskeexamen med inriktning mot onkologisk vĺrd	Legitimerad Biomedicinska analytiker med inriktning mot klinisk fysiologi
Switzerland	Fachfrau/mann für medizinisch-technischsche Radiologie HF Techniciens en radiologie médicale Tecnici di radiologia medica		
Turkey	Radyoloji Teknikeri	Radyoterapi Teknikeri	Nükleer Tıp Teknikeri
United Kingdom	Diagnostic radiographer	Therapeutic radiographer	

EFRS European Federation of Radiographer Societies

EFRS - European Federation of Radiographer Societies

Catharijnesingel 73
3511 GM Utrecht
The Netherlands

www.efrs.eu
info@efrs.eu
/EFRS.eu
@EFRadiographers