EFRS

EUROPEAN FEDERATION OF RADIOGRAPHER SOCIETIES

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

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Contents

Introduction

Since its establishment in 2008 the European Federation of Radiographer Societies (EFRS) has worked towards clarification and better understanding of the role of the radiographer in Europe through conducting Europe-wide surveys, dissemination of information and in particular through defining the title "Radiographer" with a recommendation to use only this title in documents at the European level (appendix 2). The use of one title is essential to represent this specific group in health care, working in medical imaging, radiotherapy and nuclear medicine. Of course this does not affect the use of all the different titles at the national level.

The point of view of the EFRS is that, to meet the EFRS definition of a radiographer, the level of knowledge, skills and competence of a radiographer should be at level 6 of the European Qualifications Framework (EQF) [1], which is equivalent to the QF-EHEA [2] Bachelor level.

Purpose of this document

The purpose of the document is to serve as point of reference and benchmark for educational institutions, employers and professional bodies in Europe. It may also serve individual radiographers who qualified at the sub 1st cycle Bologna level (equivalent to EQF Level 5) to seek individual recognition at EQF level 6 through a validation procedure of their non-formal and informal learning [3] after qualification.

The purpose of the document is certainly not to impose curricular content to educational institutions, but it may serve as a benchmark to institutions that currently offer, or are in the process of developing, radiography educational programmes at EQF Level 6.

If it is widely used this document may also serve to promote mobility and to facilitate and encourage lifelong learning in keeping with the aims of the EFRS.

This document also takes into account the necessity that European Educational Institutions have the social responsibility to educate radiographers for a globalised health care sector and not only for Europe. Therefore there is a requirement to educate highly skilled health professionals who are capable of making a considerable contribution to the wellbeing of a population by being able to adapt and work in countries where health care systems have human and technological limitations.

Content

Because the majority of the learning outcomes are the same for diagnostic radiography, radiation therapy and nuclear medicine this document provides a set of core learning outcomes, followed by sets of specific learning outcomes for each field. The learning outcomes are grouped in Knowledge, Skills and Competence (KSC) tables.

Magnetic resonance imaging and ultrasound are incorporated into Diagnostic Radiography, as this best matches the curriculum of the majority of educational institutions that participated the EFRS educational surveys 2010 and 2012. If the EFRS members wish and at a later stage, also sets of benchmark learning outcomes could be developed for CT, MRI and other specialised areas.

In appendix 1 you find specific KSC tables for Radiation Protection for radiographers at entry level (EQF 6) as agreed by the MEDRAPET (Medical Radiation Protection Education and Training) consortium in 2013. MEDRAPET was an EC funded project with as consortium members: ESR, EFRS, ESTRO, EFOMP, EANM and CIRSE. The guidelines will be published by the European Commission as Radiation Protection 175.

Procedure

This benchmark document was developed and a number of times revised following the input of the EFRS members by a small group of experts: Paul Bezzina (University of Malta), Peter Hogg (University of Salford), Jonathan McNulty (University College Dublin and Thomas Roding (INHolland University of Applied Sciences). The group was supported by: Val Challen (executive officer of HENRE – the EFRS educational wing) and Dorien Pronk-Larive (CEO EFRS).

Several drafts were discussed in 2012 and 2013 with the EFRS board, with the EFRS General Assembly and with the EFRS educational wing (HENRE). The EFRS General Assembly decided to add the outcomes of the MEDRAPET project to the EFRS document.

The final version was approved by the General Assembly in the EFRS AGM 2013. Related European umbrella organisations (ESR, ESTRO and EANM) were invited to review and comment upon the content.

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 earliest days there has been much debate about the role of the radiographer in the field of diagnostic imaging and radiation therapy. From the beginning the story of radiography has been one of constant, rapidly changing and ever-expanding technology and radiographers have been at the frontier of the developments that have taken place in health care delivery over the years.

In Europe there is a range of providers of radiography education, including universities, universities of applied science, technical institutes and vocational colleges. Radiography education across Europe has made great progress in the move to a student centred learning outcomes approach, which is now widely introduced and accepted.

In an attempt to standardise the education and role of the radiographer in Europe, the European subgroup of the International Society of Radiographers and Radiological Technologists (ISRRT) already published a document in 1995, where the role and the responsibilities of a radiographer are described. This follows related publications by the European Society for Radiotherapy and oncology (ESTRO) of a European radiation therapy curriculum [4] and the ongoing work of the Euro-American Advanced Competencies Working Party in nuclear medicine on entry and advanced level practice in nuclear medicine.

The former Higher Education Network for Radiography in Europe (HENRE) developed a methodology which is laid down in the Tuning Template for radiography in Europe [5, 6] to design and deliver 1st cycle degree programmes using a learning outcomes and competence framework. The HENRE Tuning document makes a clear distinction between learning outcomes and competences in order to distinguish the different roles of the most relevant players in the learning process: the academic staff and students. In the Tuning document competences represent a dynamic combination of knowledge, skills, abilities and attitudes and are distinguished between subject specific and generic ones. Learning outcomes are formulated by academic staff with competences developed or achieved by students during the learning process. In the Qualification Framework of the European Higher Education Area (QF-EHEA) based on the Dublin Descriptors, learning outcomes (including competences) are seen as the

overall results of learning. The descriptors consist of generic statements of typical expectations or competence levels of achievement and abilities associated with the Bologna cycles. The word competence is used in a broad sense, allowing for gradation of abilities and skills.

Harmonisation of education in Europe can be a result of all the actions described above, but nevertheless content and level of education programmes remain a national responsibility of the EU member states.

The European Qualifications Framework (EQF)

Agreed by the European Commission and Parliament in 2008, the European Qualification Framework (EQF) recommendation is now being put into practice across Europe. 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. It encourages countries to develop and relate their National Qualifications Framework (NQF) to the EQF so that all qualifications issued will carry a reference to the appropriate EQF Level. The National Qualifications Framework in each EU country will identify the appropriate EQF Level.

European countries are increasingly 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. Validation of the acquired competences is already well organised in some countries and European guidelines [3] have been developed for this purpose.

The EQF is closely related to the qualifications framework for the European Higher Education Area [2] The EQF may create the impression that there are two distinct overarching frameworks for higher education in Europe. It is therefore important to underline that while the wording of the EQF is not identical to that of the EHEA Framework, the two frameworks are compatible and their implementation is coordinated.

Learning outcomes and KSC tables

The EQF defines learning outcomes as statements of what a learner knows, understands and is able to do on completion of a learning process, which are defined in terms of knowledge, skills and competence.

EQF defines knowledge, skills and competence as follows:

- **Knowledge** means the outcome of the assimilation of information through learning. Knowledge is the body of facts, principles, theories and practices that is related to a field of work or study. In the context of the European Qualifications Framework knowledge is described as theoretical or factual.
- **Skills** means the ability to apply knowledge and use know-how to complete tasks and solve problems. In the context of the European Qualifications Framework skills is described as cognitive (involving the use of logical, intuitive and creative thinking) or practical (involving manual dexterity and the use of methods, materials, tools and instruments).
- **Competence** means the proven ability to use knowledge, skills and personal social and/or methodological abilities, in work or study situations and in professional and personal development. In the context of the European Qualifications Framework competence is described in terms of responsibility and autonomy.

For EQF Level 6 knowledge, skills and competence are further defined as follows:

- **Knowledge** - advanced knowledge of a field of work or study, involving a critical understanding of theories and principles.
- **Skills** - advanced skills, demonstrating mastery and innovation, required to solve complex and unpredictable problems in a specialised field of work or study.
- **Competence** - manage complex technical or professional activities or projects, taking responsibility for decision making in unpredictable work or study contexts take responsibility for managing professional development of individuals and groups.

References

[1] The European Qualifications Framework - http://ec.europa.eu/education/lifelong-learning-policy/eqf_en.htm, last accessed 08/08/2013

[2] European Higher Education Area – http://www.ehea.info, last accessed 08/08/2013

[3] Validation of non-formal and informal learning – http://ec.europa.eu/education/lifelong-learning-policy/informal_en.htm, last accessed 08/08/2013

[4] ESTRO Core Curriculum for RTTs (Radiation Therapists). 3rd edition, 2011. http://www.estro.org/binaries/content/assets/estro/school/european-curricula/recommended_core_curriculum-radiationtherapists---3rd-edition-2011.pdf, last accessed 08/08/2013

[5] 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, last accessed 08/08/2013

[6] TUNING Educational Structures in Europe - http://www.unideusto.org/tuningeu/home.html, last accessed 08/08/2013

Core Learning Outcomes

Knowledge, Skills and Competences for Diagnostic Radiography, Radiation Therapy, Nuclear Medicine 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 professional practice; K2. X, gamma and positron radiation physics; physical principles of radioactivity; radiation generation, interaction, modification and protection; K3. Radiation physics, radiation hazards, radiation biology, radio sensitivity and dosimetry; K4. Risk: benefit philosophy and principles; 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 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 applying current safety standards, legislation, guidelines and regulations; S3. Manipulate exposure parameters and variables in order to optimise dose and 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.	C1. Take individual responsibility for carrying out work in a safe manner when using 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 refusing to accept or carry out a request or referral which, in his/her professional opinion, poses a danger to the patient or is inadvisable; C4. Advise of 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 and prognosis of the most common tumours; K15. Clinical signs and symptoms related to pathologies and diseases.	S6. Recognise and describe normal and abnormal anatomical appearances as demonstrated on medical imaging and apply critical thinking in order to assess diagnostic acceptability; S7. Recognise and evaluate normal and abnormal physiology in relation to dynamic and physiologically based examinations; S8. Recognise and describe pathology, disease and trauma processes on medical imaging examinations; S9. 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.	S10. Safely, effectively and efficiently operate medical equipment; S11. Effectively and efficiently use healthcare information technology, data processing, storage, retrieval and manipulation; S12. Apply effective and safe approaches to occupational risks and health and safety.	C9. Develop spatial awareness, visual acuity and manual dexterity 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 gene-ral public.

CORE Knowledge	CORE Skills	CORE Competences
Numeracy		
K19. Importance of numeracy to practice; K20. Numerical systems.	S13. Understand, manipulate, interpret and present numerical data.	C13. Develop numerical competence for a wide range of professional activities.
Psycho-social patient care		
K21. 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; K22. Importance of gaining patient consent and of maintaining patient confidentiality.	S14. 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; S15. Ability to monitor and identify vital signs and apply basic life support and emergency procedures when appropriate;	C14. 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; C15. Inform, encourage, advise and support each patient before, during and post examination/ treatment; C16. Maintain a respectful approach to patients and carers; C17. Identify individual patient requirements and provide the necessary patient care and aftercare for the patient ; C18. Clinical reasoning based judgements made from verbal and physical presentation of individual patients; C19. 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		
K23. Communication theory and practice; K24. Verbal and non verbal communication strategies to be adopted with a wide range of service users, staff and the general public; K25. Behavioural and sociological sciences that influence communication and respect for patients, their carers and other professionals in the healthcare team.	S16. Ability to identify and understand how to communicate effectively; S17. Communicate utilising appropriate professional terminology; S18. Communicate effectively with service users, carers, staff and the public applying approaches that take into account the physical, psychological, social and cultural needs and which are anti-discriminatory and anti-oppressive; S19. Communicate effectively and efficiently with patients, carers, staff in relation to – radiation protection, information regarding examination and treatment procedures, advice , care pathways and professional opinion; S20. Formulate and provide information to patients and carers about processes and procedures related to professional practice; S21. Communicate with non experts in the field.	C20. Communicate (verbally and in writing) and participate in a multidisciplinary, multicultural and/or international environment with regard to profession-related issues; C21. Communicate with, advise and instruct other professional groups on profession-related issues and ensure an appropriate chain of care; C22. Instruct, teach and/or mentor staff and students in order to contribute to the development and promotion of their expertise; C23. Furnish third parties with information and education tailored to the target group.
Pharmacology		
K26. 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; K27. Quality control procedures conducted in association with the radiopharmacy	S22. Safely administer contrast agents and other drugs to include cannulation and administration under protocol; S23. Where and when appropriate create radiopharmaceuticals to the standards set out in the relevant legal and policy documents.	C24. Responsible performance of professional task in an autonomous manner with qualified assistance; C25. Respond appropriately to contra-indications, complications and emergencies; C26. Where and when create radiopharmaceuticals to a standard suitable for administration to humans (e.g. white cells).

CORE Knowledge	CORE Skills	CORE Competences
Quality Assurance & Innovation		
K28. Quality assurance and quality control 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; K29. Audits of clinical practice including patient care and diagnostic reference levels (DRLs).	S24. 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; S25. Generate and convey new ideas or generate innovative solutions to known problems and situations.	C27. Be able to, within a multidisciplinary collaborative context, contribute to evaluation, improvement and maintenance of the quality of professional practice; C28. Be able to contribute to the content-related development and profiling of the profession by initiating and implementing quality management and innovation processes; C29. Be able to note new developments and implements new guidelines in professional practice.
Ethics		
K30. Ethical/moral theories and ethical decision making, including the relationship between ethics and the law and the impact on practice.	S26. Seek appropriate informed consent for any examination/treatment to proceed and establish an effective relationship with the patient S27. Use appropriate and correct identification, address and treatment of the patient showing them dignity and respect; S28. Adhere to the professional codes of ethics and conduct including maintenance of patient confidentiality; S29. Act on the basis of a critically reflective attitude and take into account professional codes and rules of behaviours, reserved processes and legal frameworks.	C30. Take responsibility for his/her own actions; C31. Recognise the limitations to his/her scope of practice and competence and seek advice and guidance accordingly; C32. Ethically plan and manage work loads and work flow in an effective and efficient manner; C33. Ethically manage the use and consumption of resources and materials so as to ensure clarity regarding the use, application and availability of the remaining resources and materials; C34. Demonstrate an ethical approach and commitment to patients, carers, staff; C35. Exemplify good character within a professional context and internalise professional standards in private life.

CORE Knowledge	CORE Skills	CORE Competences
Inter-professional & Team Work		
K31. The importance of inter-professional working relationships within a multi-disciplinary health-care team in order to ensure the best quality of patient care and the best possible patient outcomes.	S30. Exhibit the appropriate professional attitudes and behaviour expected of a fully integrated member of the multi-disciplinary health care team to ensure the best quality of patient care and the best possible patient outcomes.	C36. Undertake to function both independently and as part of a team within a work organisation; C37. Whenever possible make an appropriate and argued contribution within a multidisciplinary team; C38. Whenever possible contribute to an effective interdisciplinary, multicultural and/or international collaboration and chain of care; C39. Functionally attune one's own professional actions within the confines of one's expertise and ability to the actions of other members of the multidisciplinary team; C40. Seek to integrate instructions and/or directives from the staff of one's own or other departments into one's own actions; C41. Whenever possible contribute to team development and conflict resolution.

CORE Knowledge	CORE Skills	CORE Competences
Research and Audit		
K32. The importance of audit, research and evidence based practice including: the stages in the research process, research ethics, statistics and statistical analysis to facilitate a deeper understanding of research findings and clinical audit.	S31. Use appropriate information gathering techniques and bibliographic skills; S32. Use and undertake audits; S33. Utilise, interpret, evaluate and analyse data; S34. Critically appraise published literature; S35. Identify the principles of evidence-based practice and the research process; S36. Statistical competence in order to interrogate data.	C42. Apply available relevant national and international (scientific) insights, theories, concepts and research results to issues in their professional practice; C43. 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). C44. Carry out short-term and practice-oriented research or clinical audit, either independently or in collaboration with colleagues, to improve the quality of care; C45. Participate in clinical audit and applied research for the further development of professional practice and its scientific foundation; C46. Present and publish results of clinical audit and applied research.
Professional Aspects		
K33. Major reference points of the discipline and knowledge of how to interrelate theory and practice constructively; K34. The history and current status of the profession both nationally and internationally to include the promotion of the profession within the health sector and to the general public, the education of the general public about the risks and benefits of medical imaging examinations/radiation therapy treatments/nuclear medicine procedures so that they can make more informed judgements.	S37. Critically reflect on and evaluate his/her own experience and practice; S38. Plan and organise professional activity and recognise the value of managing change and establishing opportunities for professional development; S39. Meet deadlines for the completion of work to required standards whether working independently or as part of a team; S40. Demonstrate entry level leadership skills to include organisational skills, communication and management.	C47. Describe new developments or innovations relating to profession-related issues in a national or international context in a factually correct, understandable and accessible manner; C48. Contribute to the content-related development and profiling of the profession by initiating and implementing quality management and innovation processes; C49. Within a multidisciplinary collaborative context, contribute to evaluation, improvement and maintenance of the quality of professional practice; C50. Note new developments and implement new guidelines in professional practice.

CORE Knowledge	CORE Skills	CORE Competences
Personal and Professional Development		
K35. The importance of developing and reflecting on professional activity-including the reflective process; K36. The importance of maintaining competence and confidence through the activity of continued professional development (CPD).	S41. Recognise the need for CPD and Life Long Learning (LLL); S42. Ability to audit own skills and set objectives through the evaluation of one's own actions through self reflection; S43. Professional awareness and the ability to contribute to the education of the general public concerning the risks and benefits of radiography so that they can make more informed judgements.	C51. Critically self reflect and the potential to work autonomously; C52. Play an active role in promoting one's own professional awareness and in developing one's (degree programme or professional) competences; C53. Manage one's own career (development) as a professional; C54. Where possible, translate trends and developments in professional practice (national and international) into one's own professional practice; C55. Seek to work within a multidisciplinary team, evaluate the organisational, content-related and methodical aspects of professional practice; C56. Seek to translate, in situations involving supervision between colleagues, given and received feedback into feasible and realistic activities for achieving improvement; C57. Promote the expertise of colleagues and the professional group.

Specific learning outcomes for 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
Diagnostic Radiography		
The diagnostic radiographer should be able to demonstrate advanced knowledge, involving critical understanding of theory and the principles of:	The diagnostic radiographer should be able to demonstrate mastery and innovation of skills through the ability to:	The 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 Radiation Therapy at entry level

In addition to the core learning outcomes, the radiation therapy radiographer/RTT should be able to demonstrate the following knowledge, skills and competence

Knowledge	Skills	Competence
Radiation Therapy		
The radiation therapy radiographer/RTT should be able to demonstrate advanced knowledge, involving critical understanding of theory and the principles of:	The radiation therapy radiographer /RTT should be able to demonstrate mastery and innovation of skills through the ability to:	The radiation therapy radiography /RTT 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; K3. Beams Eye View (BEV), Gross Target Volume (GTV), Clinical Target Volume (CTV), Planning Target Volume (PTV), Organs at Risk (OAR), Dose Volume Histograms (DVH); K4. Radiation therapy verification systems; K5. Equipment for the delivery of treatment-including linear accelerator, cobalt, SXT/orthovoltage, electrons, brachytherapy, stereotactic R/T, IMRT, IGRT, gated R/T, proton therapy, unsealed source therapies; K6. 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; K7. Technical appraisal of diagnostic images for tumour localisation and treatment planning; K8. Side effects of radiotherapy treatments; K9. Tissue inhomogeneity, wedges, weight factors, beam shape and properties.	S1. Producing and appraising an appropriate treatment plan that meets the requirements of the treatment prescription; S2. Carrying out and evaluating an external beam 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 systems.	C1. C 1. able to define treatment cycles in terms of time, taking into account priorities, available staff and material possibilities; C2. C2. numerical competence in mathematical processes involved in radiation dose calculations and distribution; C3. C3. collaborate with external agencies in the provision of continual care for patients with cancer; C4. C4. participation in the implementation of national or international clinical trials into the department.

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 competence

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 the range of CT scanners in hybrid environments; K2. The effect that the range of CT acquisition parameters has 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 scanner; manipulate acquisition parameters which effect 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.

APPENDICES

Appendix 1 - Medrapet report 2013

Chapter 6. Learning outcomes for radiographers 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)

[2] Waterstram-Rich K, Hogg P, Testanera G, Medvedec H, Dennan SE, Knapp W, Thomas N, Hunt K, Pickett M, Scott A, Dillehay G (2011). Euro-American Discussion Document on Entry-Level and Advanced Practice in Nuclear Medicine, J. Nucl. Med. Technol., 39: 240-248.http://tech.snmjournals.org/content/39/3/240.full.pdf+html(Last time accessed was on the 24th of March 2013)

[3] ESTRO, 2011. Recommended ESTRO Core Curriculum for RTTs (Radiation TherapisTs). 3rd edition. ESTRO, Brussels, Belgium.http://estro-education.org/courses/Documents/Recommended_Core_Curriculum%20RadiationTherapisTs%20-%203rd%20edition%202011.pdf (last time accessed 24th of March 2013

[4] IAEA, 2002. Safety Standards Series No. RS-G-1.5, Radiological Protection for Medical Exposure to Ionizing Radiation, IAEA, Vienna, 2002, http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1117_scr.pdf (Last time accessed was on the 24th of March 2013)

[5] Royal College of Radiologist and the Society and College of Radiographers (2012) Team working in clinical imaging

[6] HPC, 2009. Standards of Proficiency: Radiographers. Health Professions Council, London, UK.http://www.hpc-uk.org/assets/documents/10000DBDStandards_of_Proficiency_Radiographers.pdf(Last time accessed was on the 24th of March 2013)

[7] HENRE, 2008. Overview of the Tuning Template for Radiography in Europe. HENRE.http://www.unideusto.org/tuningeu/images/stories/template/Radiography_overview.pdf(Last time accessed was on the 24th of December 2012)

[8] EC, 2008. European Commission: Explaining the European Qualifications Framework for Lifelong Learning. Office for Official Publications of the European Communities, Luxembourg.http://ec.europa.eu/education/lifelong-learning-policy/doc44_en.htm(Last time accessed was on the 24th of March 2013)

[9] European Parliament and Council (2008) Recommendation 2008/C 111/01 on the establishment of the European Qualifications Framework for Lifelong Learning. Official Journal of the European Union 6.5.2008, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=oj:c:2008:111:0001:0007:en:pdf(Last time accessed was on the 124h of March 2013)

[10] ICRP, 2010. Draft report for consultation4811-3039-3350: Radiological protection education and training for healthcare staff and students.

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; K2. Explain radiation physics, radiation hazards, radiation biology and dosimetry; K3. Understand risk: benefit philosophy and principles involved in all aspects of radiography; K4. Identify current national and international radiation protection legislation and regulations relating to staff, patients, carers and the wider general public; K5. Explain physics underpinning non-ionising imaging techniques including magnetic resonance imaging and ultrasound along with associated safety considerations; K6. Describe professional roles and responsibilities in terms of aspects of justification and optimisation; 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; K8. Understand occupational risks, health and safety that may be encountered such as safe moving and handling of patients and equipment; 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; K10. Identify the different determinants of radiation risk perception; know the pit-falls of communication on radiation risks.	S1. Use the appropriate 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 applying current safety standards, legislation, guidelines and regulations; 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; S4. Use and undertake clinical audits; S5. Identify the principles of evidence-based practice and the research process; S6. Critically reflect on and evaluate his/her own experience and practice; S7. Participate in CPD; 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; S9. Identify different image quality standards for different techniques; S10. Apply the concepts and tools for radiation protection optimisation.	C1. Practise effectively, accurately and safely and within the guidance of legal, ethical and professional frameworks; C2. Use appropriate and correct identification, address and treatment of the patient (and any accompanying carer if appropriate); C3. Avoid unnecessary exposures and minimise necessary exposures as part of optimisation; C4. Seek consent for any examination/treatment to proceed; C5. Carry out work in a safe manner when using ionising radiation, taking into account current safety standards, guidelines and regulations; 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; C7. Refuse to accept or carry out a request or referral which, in his/her professional opinion, is dangerous or inadvisable; C8. Recognise the limitations to his/her scope of competence and seek advice and guidance accordingly; 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).

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

Knowledge (facts, principles, theories, practices)	Skills (cognitive and practical)	Competence (responsibility and autonomy)
Additional for radiology		
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 technologists

Knowledge (facts, principles, theories, practices)	Skills (cognitive and practical)	Competence (responsibility and autonomy)
Additional for nuclear medicine		
K1. Explain the physical principles of how radionuclides can be generated; K2. Explain how radionuclides can be physically shielded (gamma, beta, positron); K3. For the range of therapy and diagnostic procedures, explain the biological basis on which radiopharmaceutical localisation occurs; K4. Understand the risk-benefit philosophy as applied to 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 doses for children can be varied from those of adults; 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); 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. Take responsibility for drawing up the correct quantity of radiopharmaceutical for administration, taking into account DRLs; C7. Working within a devolved framework, justify the diagnostic NM procedure; 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 radioactive 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 such that 'no / a minor amount' is residual within the dispensing device (e.g. 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 DNA damage; K25. Describe the cellular effects, mechanisms of cell death.	S11. Perform and interpret QC tests to determine whether NM equipment is within manufacturer specification; S12. Draw up the correct quantity of radiopharmaceutical 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 radioactive spills in a safe and efficient manner.

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

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.	S1. Use medical devices in radiation therapy, including medical imaging devices, used for tumour localisation and treatment planning in a safe and effective manner	C1. Able to take into account, from the perspective of the patient, the technical, clinical and treatment while it is being conducted
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	S2. Analyse the properties of particle and electromagnetic radiation	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
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	S3. Apply treatment planning including 3D planning, virtual and CT simulation and applies these procedures to plan patients' treatments	C3. Work in an independent, methodical and evidence-based manner in terms of quality, complete the treatment and report accordingly
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	S4. Prepare treatment plans using IMRT and other techniques such as stereotactic, particle and IGRT	C4. Able to work in a safe manner when carrying out treatments with ionizing radiation, taking into account current safety standards, guidelines and regulations
K5. Explain DNA damage	S5. Define the target and OAR using ICRU terminology	C5. Critically evaluate the dose distribution and DVHs
K6. Describe the cellular effects, mechanisms of cell death	S6. Describe how DVHs are created and used to evaluate plans	C6. Optimise and evaluate the plan options
K7. Explain the cell survival curves	S7. Relate the influence of changing planning parameters on DVHs	C7. Assess the daily physical and psychological status of the patient prior to treatment
K8. Describe the normal tissue, solid tumour and leukaemia systems	S8. Use radiation protection methods relating to staff, patients and the general public, taking into account current safety standards, guidelines and regulations	C8. Record all side effects and advise the patient on their management in accordance with department protocol
K9. Explain the effects of oxygen, sensitizers and protectors	S9. Justify and optimise all procedures effectively	C9. Calculate/check monitor units and treatment times
K10. Explain the effect of time-dose-fractionation, LET and different radiation modalities and interaction between cytotoxic therapy and radiation	S10. Recognize OAR on medical images for tumour localisation and treatment planning;	C10. Check treatment prescription calculations for accuracy and alert clinician of any discrepancies

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	C11. Check decay tables/exposure rates for Cobalt units are updated
K12. Knowledge and understanding of Beams Eye View (BEV)	S12. Identify the side effects associated with the individual treatment	C12. Apply safety procedures when using brachytherapy sources
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	C13. Assess patients undergoing external beam radiotherapy and brachytherapy and refer to the radiation oncologist or other health professional as appropriate
K14. Knowledge and understanding of Organs at Risk (OAR)	S14. Analyse stochastic and deterministic effects	C14. Assess the practical problems associated with machine and accessory equipment limitations and respond accordingly
K15. Knowledge and understanding of Dose Volume Histograms (DVH)	S15. Define the parameters routinely used	C15. Optimise and evaluate plan options
K16. Explain the collimating systems	S16. Recognise the critical structures on the verification images	C16. Carry out manual calculations
K17. Describe Brachytherapy systems	S17. Identify the imaging protocol	C17. Engage in QA and follow safety policies
K18. Explain absorbed dose	S18. Identify the daily entrance and exit dose and dose level of critical organs	C18. Check if all parameters, devices and settings are correct
K19. Define target absorbed dose specification in external RT	S19. Be familiar with reporting system and reporting protocols	C19. Carry out in vivo dosimetry
K20. Define target absorbed dose specification in brachytherapy	S20. Describe the radiation hazards and how they are managed	C20. Evaluate results, take corrective action as per protocol and report any inconsistency
K21. Illustrate algorithms for 3D dose calculations	S21. Effective, safe and efficient use of positioning, immobilisation and beam shielding devices used in radiation therapy	C21. Analyse and record the results and report any deviations
K22. Explain applications of conformal RT, IMRT, IGRT, stereotactic RT and particle therapy	S22. Use radiation therapy verification systems safely, effectively and efficiently	C22. Report incidents and near incidents to the multidisciplinary team
K23. Describe radiation weighting factor	S23. Perform, record and analyse QC activities	C23. Examine any incident or near incidents and how they can be prevented in the future
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	C24. Routinely inspect the area to ensure that radiation protection measures are in place and functional
K25. Explain equivalent dose – tissue weighting factor		
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 to perform 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 may also include the use of:

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

THERAPEUTIC radiographers (Radiotherapy)

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

- simulation with X-rays or magnetic fields, to target the area to be treated.
- computer planning to produce a plan of the dose distribution across the area to be treated, based on the simulation
- the production of individual immobilization or beam attenuation devices
- irradiation of the tumour with external beams, or with radio-active sources

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 29.

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	Geislafrćđingur		
Italy	Tecnico sanitario di radiologia medica		
Ireland	Radiographer	Radiation therapist	Radiographer
Latvia	Radiologa asistents		
Lithuania	Radiologijos technologas		
Macedonia (Fyrom)	Radioloski tehnolog		
Malta	Radiographer		
Netherlands	Medisch Beeldvormings- en Bestralingsdeskundige (MBB)		
	Radiodiagnostisch laborant	Radiotherapeutisch laborant	Medisch Nucleair werker
Norway	Radiograf	Strĺleterapeut	Radiograf
Poland	Elektroradiologów, 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		
United Kingdom	Diagnostic radiographer	Therapeutic radiographer	

EFRS European Federation of Radiographer Societies

EFRS - European Federation of Radiographer Societies

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