

Harris, Phil, Vinorum, Agnes, Henner, Anja, Lança, Luís, Paulo, Graciano, Vieira, Luísa, Pellicano, Gianni and Eaton, Carena (2009) Tuning template for radiography in Europe. Tuning Academy. (Unpublished)

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Tuning Template for Radiography in Europe

The following document is the **Tuning Template for Radiography Education in Europe**. Radiography is one of the [Socrates Thematic Networks](#) which will incorporate Tuning methodology. The Higher Education Network for Radiography in Europe (HENRE Network) will thus play a central role in describing and updating radiography qualifications making considerable strides in relation to the Bologna agenda.

This present draft was prepared by Phil Harris (Sub-Group 1 Coordinator, University of Cumbria, UK), Agnes Vinorum (Oslo University College, Norway), Anja Henner (Oulu University of Applied Sciences, Finland), Luís Lança (Escola Superior de Tecnologia da Saúde de Lisboa, Portugal), Graciano Paulo (Escola Superior de Tecnologia da Saúde de Coimbra, Portugal), Luísa Vieira (Escola Superior de Saude Ribiero Sanches, Portugal), Gianni Pellicano (Universita Deggli Studi di Firenze, Italy) and Carena Eaton (University of Salford, UK) following sub-group 1 meetings held in Utrecht on 25th-27th October 2007 and in Lisbon on 17th-20th April 2008.

The first draft of this Tuning Template was originally prepared by Phil Harris, Anja Kettunen, Luís Lança, Margarida Ribeiro and Luísa Vieira in sub-group 1 meeting held at Lancaster in 18th/19th May 2007.

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Introduction to Radiography

Within the context of this Tuning template the reader should consider the term “Radiographer” to refer to the role of both Diagnostic and Therapeutic Radiographers and the scope of practice to relate to Diagnostic Radiography, Radionuclide Imaging and Radiotherapy.

It is expected that the radiographer will have professional autonomy and accountability, develop good professional relationships, develop personal and professional skills and demonstrate an ethical and knowledgeable understanding of the profession. It is also expected that the application of radiographic and radiotherapeutic practice in securing, maintaining or improving health and well-being; the development of knowledge, understanding and skills that underpin their education and training will contribute to future health and wellbeing of the patient. It is considered vital that professional advancement arises out of evidence-based practice and is informed through focused research.

These healthcare professionals are able to plan, organize, apply and evaluate their work process with the aims of promoting health, preventing disease, making the diagnosis, and treating diseases. The radiographer is a healthcare team member who interacts with other professionals in the primary and secondary healthcare environment to provide an optimum diagnostic or therapeutic outcome.

The radiographer has the responsibility to:

- Plan, prepare and perform safe and accurate imaging examinations, using a wide range of sophisticated equipment and techniques in the Diagnostic field;
- Plan, prepare and perform safe and accurate high-energy radiation treatments, using a wide range of sophisticated equipment and techniques in the Therapeutic field.

While performing their role the radiographer is responsible for the radiation protection, patient care and quality assurance of the radiological or radiotherapeutic process.

Throughout Europe, in most countries, the national professional regulations govern the profession of radiography and within some countries professional/governmental registration is a requirement for practice. This system protects the interests of the service user. The radiography profession is typically governed by national Ministries responsible for Education and for Health.

Furthermore, the radiography profession is regulated by the Directive 2005/36/EC of the European Parliament and of the Council on the recognition of professional qualifications; member states retaining the right to lay down the minimum level of qualification required to ensure the quality of the services provided on their territory.

Degree profile(s)

First cycle education at bachelor level is the desired qualification for a basic/first post radiographer.

Second cycle education at a Master's level is the required qualification in a specific subject area in radiography and is intended for those who successfully completed first cycle studies.

Third cycle education at a Doctoral level is the qualification aimed towards those who wish to research in the radiography field and is intended for those who successfully completed second cycle studies in the healthcare field. Radiographers can also follow doctoral programmes in other disciplines.

Degree profiles in radiography vary throughout Europe, in terms of the requirements for first post competencies related to specified imaging and therapeutic modalities. This has arisen from the different national traditions from which the profession developed, from the requirements of the service and from the variety of educational programmes which exist across Europe.

The Bologna process for Higher Education has provided the means to spearhead the development of radiography programmes which aim to 'tune' with each other eventually, in the long term, supporting the free flow of labour across the whole of Europe.

Typical degrees and occupations offered in Radiography

	Typical degrees offered	Typical occupations
First cycle	<p>First cycle education at bachelor level is the required qualification to enable radiographers to practise in the fields of diagnostic radiography, nuclear medicine and therapeutic radiography.</p> <p>Typical degrees offered are bachelor in Radiography, Nuclear Medicine and Radiotherapy, or combinations of the above.</p>	<ul style="list-style-type: none"> • Public and private sector hospitals, clinics • Industry, technical advisor, sales advisor • Education, trainer • Research assistant • System administration • Veterinary
Second cycle	<p>Two different groups of Masters level qualifications are available: in the clinically focused areas and in the non-clinically focused areas.</p> <p>Example of clinically focused qualifications:</p> <ul style="list-style-type: none"> • medical imaging, therapeutic radiography, nuclear medicine, ultrasound, CT, MRI, dose optimization, health/medical ethics <p>Example of non-clinically focused qualifications:</p> <ul style="list-style-type: none"> • management, education, radiology information systems, ethics, quality assurance 	<ul style="list-style-type: none"> • Radiographer in specialist fields • Advanced practitioner • Clinical service manager • Technical consultant • Management • Education, lecturer
Third cycle	<p>The research doctorate is related to the creation and expansion of knowledge within the professional field.</p>	<ul style="list-style-type: none"> • Professor • Associate Professor • Project leader • Research supervisor • Principal researcher • Consultant practitioner

The role of Radiography in other degree programmes

Radiography is relevant to other professions and disciplines. Subjects of interest to other professions may include dental radiography, veterinary radiography, art radiography, forensic radiography, hospital design, radiation safety, radiological image interpretation, radiopharmaceuticals, applied anatomy and physiology for imaging, etc.

Possible target groups include nursing, allied health and medical professions, engineers, architects, anthropologists, art restorations specialists, teachers to name a few.

Interdisciplinary education is an important part of all healthcare programmes. The aim of this is to increase mutual understanding and promote multidisciplinary teamwork. Subject areas in interdisciplinary education include health and welfare, legislation, ethics, communication, research methods and others.

Learning outcomes & competencies – cycle level descriptors

First cycle level descriptors

TUNING distinguishes three types of generic competences:

Instrumental competences: cognitive abilities, methodological abilities, technological abilities and linguistic abilities

Interpersonal competences: individual abilities like social skills (social interaction and co-operation)

Systemic competences: abilities and skills concerning whole systems (combination of understanding, sensibility and knowledge; prior acquisition of instrumental and interpersonal competences required)

The generic competencies to be achieved at the first cycle level by a Bachelor in radiography include:

Instrumental competencies - the skills and capacity for analysis and synthesis, organization, general knowledge and understanding of radiography, knowledge of own and a second language related to:

- Reflection on practice
- Positive attitude to responsibility for own learning
- Evaluation
- Problem Solving
- Research Skills

Interpersonal competencies – the skills required for teamwork, communication, positive criticism and self-criticism, ethical approaches, integration within multidisciplinary teams, understanding diversity and multi-cultural issues, related to the:

- Professional autonomy and accountability of the radiographer
- Professional relationships of the radiographer
- Personal and professional skills of the radiographer
- Profession and employer context

Systemic competencies – the skills to apply theoretical knowledge in practice, to learn, adapt to new situations, generate new ideas, leadership, and autonomy related to:

- Quality
- Project design and management
- Creativity

Note: See Appendices 3 and 4 for a detailed description of generic and subject specific broad competencies as developed by the HENRE TUNING group

Learning outcomes and competences- cycle level descriptors

Subject specific competences

Required competences are described hereunder. These are organised in sections describing: skills attributable to all radiographers, skills in diagnostic image production, radiotherapy skills, skills in quality assurance and skills in radiation safety. It should be noted that CPD and research skills are pertinent to each of the areas designated below.

First cycle level descriptor in radiography degree programme; a radiographer qualified with a bachelor degree is able to:

- care for and advise patients, family and carers, colleagues in diagnostic radiography and radiation therapy
- develop ethically sustainable decision making, health promotion and patient care attitudes, participating also in the continuity of patient care
- identify individual patient requirements for the planning, carrying out and evaluation of care delivered, based on optimal principles of patient care
- deal with ethical dilemmas arising in the workplace
- assess and administer essential medication used in the professional context
- show operational understanding of procedures for emergency first aid
- show knowledge of hospital acquired and other infections and the use of appropriate aseptic techniques
- show intercultural awareness and sensitivity in the workplace
- ensure confidentiality in the processing/handling of patient data
- be prepared to mentor students and new employees

Competences in diagnostic imaging

- use appropriate protocols and devices to carry out the optimal imaging examinations for specific medical conditions dependent on an overall assessment of the patient's condition
- use professional decision making, independently or as a team member in medical imaging procedures
- apply comprehensive understanding of imaging physics and human anatomy, physiology and pathology in the optimal production of high quality images
- understand the administrative and decision-making structures in departments of radiology
- assess and administer medicines, contrast media and radio pharmaceuticals to ensure the safe use of these in diagnostic imaging
- have a reflective attitude regarding the relationship between technology and human beings regarding risk analysis, eg in areas like the advisability to the individual of radiological examinations

Competences in radiation therapy

- optimise clinical practice protocols used in planning, simulation and administration of radiation therapies
- use professional decision making, independently or as a team member in planning and carrying out radiation therapy
- develop understanding of the administrative procedures used within radiation therapy and understand their meaning for total patient care
- be cognisant with administrative procedures used within radiation therapy and understand their implications for overall patient care

Competences in quality assurance in radiography and radiation therapy

- understand the key concepts related to quality development, control and assurance
- initiate key quality controls and actively contribute to ongoing quality improvement processes in the workplace
- evaluate and implement measures conducive to continual professional development and the optimisation of protocols
- set quality assured and evidence based standards in radiography and radiation therapy plan, measure and analyse outcomes as part of multi professional team
- understand implications for the budget of working practice in relation to radiotherapeutic medical device maintenance protocols

Competences relative to radiation safety

- practise the profession in accordance with current internationally approved statutes and regulations concerning the medical use of ionizing radiation
- optimally reduce and calculate effective radiation doses for patients, staff and carers
- understand and use radiation protection protocols
- advise other professionals regarding safe practice in this area
- set dose reference levels for all examinations and keep them optimised and updated
- critical approach to the use of ionising radiation

Second cycle level descriptors based on the Dublin Descriptors and on the European Qualifications Framework level 7 learning outcomes were developed by the EU funded European Masters Programme in Medical Imaging (EMPIMI) curriculum development project group which is a direct product of HENRE.

HENRE Second Cycle Competences are as follows:-

Second cycle level descriptor in radiography

In addition to the level of competence demonstrated by radiographers who have completed the first cycle.

Knowledge and Understanding

A radiographer qualified with a Masters degree is able to:

- identify, formulate, plan, develop and conduct independently or semi-independently research in the appropriate field of medical imaging or radiotherapy
- demonstrate the ability to improve and innovate and to determine the fundamental issues of the profession
- use specialized theoretical and practical knowledge in applying ideas
- demonstrate critical awareness of knowledge issues in the relevant field and at the interface of different fields
- demonstrate the ability to use advanced practice skills in the relevant field

Application of Knowledge and Understanding

A radiographer qualified with a Masters degree is able to:

- apply knowledge and understanding through problem solving abilities in new or unfamiliar environments
- demonstrate a commitment to improving and innovating practice and services
- apply scientific methods in practice and critically appraise strategies that enable practitioners to manage change and promote quality care
- undertake a position with more challenging responsibilities and act as clinical expert or advisor or consultant in the appropriate field

Making Judgments

A radiographer qualified with a Masters degree is able to:

- integrate knowledge, handle complexity and formulate judgements with incomplete or limited information
- reflect on social and ethical responsibilities linked to the application of knowledge and judgements
- appraise the literature to evaluate the relationship between radiography, illness, health and well being
- demonstrate the fundamental issues of radiography from a broad and deep perspective

Communication

A radiographer qualified with a Masters degree is able to:

- communicate at an advanced level to specialist and non specialist audiences
- demonstrate an ethical approach to all service users at an advanced level
- operate effectively and confidently across national and international borders and within different cultures
- participate in debates related to radiography within a wide health and social context

Learning Skills

A radiographer qualified with a Masters degree is able to:

- demonstrate the learning skills of an autonomous/ self directed learner
- use radiography theories and research methodologies and methods in an independent, autonomous manner
- demonstrate the ability to operate and adapt in challenging and rapidly changing environments
-

Third cycle level descriptors in radiography

Radiography graduates who have completed both the first and second cycles are eligible to proceed to the third cycle in most European countries. There are some exceptions to this across Europe. These descriptors have yet to be developed by the HENRE network together with the EMPIMI group as yet.

The areas for radiographers to pursue third cycle awards may be A. radiography professional awards; B. research awards; C. taught awards from any number of Higher Education Institutions (HEIs) across Europe and beyond.

Consultation process with stakeholders

When the Tuning project started there were few common platforms to address the Directives and stakeholders' involvement.

Engaging with the Tuning process for radiography, initially involved a steering group from HENRE. HENRE therefore consulted with a number of different agencies and professional groups. Within its membership are academics from (HEIs) and other educational institutions offering radiography educational programmes, radiography practitioners, national radiography societies from across Europe, representing employers and practitioners and others. Academics involved in the educational process of radiographers include, in addition to qualified radiographers, physicists, radiologists and others. Other stakeholders with interests in radiography and radiation protection include dentists and nurses. Students were also consulted in relation to both generic and subject specific competencies.

Radiography practitioners, in a number of European countries had the opportunity to feed back and comment on the generic and specific competencies through a web-based questionnaire in May 2008.

The results of this questionnaire revealed that all subject specific competencies received mean scores higher than 2.9 (scale 1-4) for 1st cycle education .

Overall, there was a clear acceptance of the competencies with a high correlation between academics, clinicians and students.

All three groups gave high scoring to competencies related to informing patients, working in a multidisciplinary team and optimising radiation dose management. In addition, theoretical concepts underpinning radiography were evaluating needs of patients and processes and critically questioning radiological referrals

Regarding the generic competences the following were scored highest for all three groups, showing a high correlation: a capacity for applying knowledge in practice, the ability to evaluate and maintain the quality of work produced, a clear demonstration of team working skills and the capacity to reflect on experience in practice

Generic competencies that scored low were least important at 1st cycle to all 3 groups of participants were demonstration of initiative and leadership capacities; knowledge of a second language; working in an international context and involvement in project design and management.

Workload and ECTS

Trends and differences within the European Higher Education area

In the European Higher Education area it is possible to find several models of education in Radiography field. Even after the implementation of Bologna Process one can identify radiography courses with variations from 180 to 240 ECTS. Whilst there do not appear to be significant trends in the way ECTS are allocated, throughout Europe, historical developments in radiography have led to differences in curricula models and consequently have led to a variety of allocation of ECTS.

The following differences are identified as to why some programmes may have more than 180 ECTS:

- Technical and professional model of intervention within the scope of practice in healthcare:
 1. The need of obtaining solid competencies concerning the use of ionizing radiation and fully apply the concepts implemented by EURATOM directives;
 2. The existence of a broad diversity of diagnostic and therapeutic methods in the field of diagnostic and therapeutic radiography;
 3. An adequate preparation in the administration of contrast media and radiopharmaceuticals, including the actions involved in life emergency procedures related with adverse reactions;
- The demand of the development on the personal maturity of the recent graduated, concerning the nature of their professional practice:

4. Clinical accountability – the Bachelor in Radiography is ethical, deontological and legally responsible for their professional acts;
5. Professional identity and autonomy, concerning their role in a multidisciplinary healthcare team.

Expected workloads expressed in ECTS:

First cycle	240 ECTS in total are recommended (90 ECTS are achieved in clinical practice of which 60 ECTS are achieved in clinical placement)
Second cycle	120 ECTS are recommended for a research-based Masters 60 to 90 ECTS as a minimum requirement for a professionally oriented Masters dependent on the ECTS achieved on the 1 st cycle
Third cycle	180 ECTS are recommended

Recommended ECTS for the first cycle level are as follows:

Scientific areas in the curriculum	ECTS	ECTS %
Basic sciences	90	38
Broad radiographic sciences	30	12
Clinical radiographic sciences	90	38
Complementary sciences	20	8
Electives	10	4
Total	240	100

Learning, teaching and assessment

Due to implicit human involvement in radiography practice, it is considered important that students have the opportunity to work in small groups for some of their course. However it is recognised that this method of delivery is resource intensive in comparison with other forms of delivery. There has been an increasing use of reflective, critical approaches to learning matched by the use of information technology to support web based and work place learning. Interdisciplinary activity is seen to play an important part in developing the team working skills and practices of radiographers.

Practical skills are often developed through observation of practice, demonstrations, simulations, role play and exposure and engagement in real clinical experiences.

Resources are now being allocated to support learners in practice and to prepare students for practice through clinically based x-ray laboratories, clinical skills laboratories and through the use of simulations or virtual practice.

Assessment strategies in radiography at first cycle with pre-registration courses need to address both theoretical and practical based competences. Diverse strategies are used to reflect the assessment of knowledge, skills, attributes and professional values. In the interests of public safety, each programme will identify core components that must be passed in order to achieve the necessary licence/registration to practice.

Learning and teaching in radiography typically involves a combination of the following:

- **Lectures:** These are very time-efficient for students to learn a large part of the material involved in the deep knowledge of radiography. Students may prepare lecture notes. However supporting information can be provided using electronic resources.
- **Practical sessions:** May be organised in tandem with lectures. The aim of practical sessions is two-fold: understanding the theoretical material through examples and applications to problems.
- **X-ray laboratories or clinical skills laboratories:** The students can practice the safe use of radiation, radiation protection and patient care in a simulated environment. In the first practice phantoms are used but patients are examined when students' skills are developed.

- **Problem based learning:**The presentation of appropriately selected and designed problems develop the ability of students to think critically, creatively and analytically, to find and use learning resources and become team participants which leading to the development of self motivated, independent learners.
- **Reflective practice:** Critical analysis and self awareness is developed through the process of reflection on learning experiences in clinical practice as a way of improving competence and developing professional approaches to healthcare.
- **Case Studies:**The collection and presentation of detailed in depth information about an individual or a group used as a form of qualitative research to develop an holistic understanding of a condition or a situation.
- **Research projects:** These are done individually or in small groups to solve complicated problems relating to the patient, to radiography and to radiation protection. Project, particularly significant final year projects, also affords the opportunity to develop student's understanding of the importance of the research in the field of radiography. The final year project or dissertation is likely to have a practical significance in addition to allowing students to develop their verbal and written communication skills.
- **Observing expert practice:** This will usually allow for a one-to-one interchange between the expert and student and is often used in the practical learning environment. It is, by its nature, a highly intensive and costly method of training. However, the costs reduce significantly when the expert is undertaking their normal clinical practice.

Quality enhancement

Quality enhancement may be considered as a deliberate process of change leading to improvement (LTSN generic centre)

HENRE has provided the means for radiography stakeholders across Europe to identify issues which may lead to the quality enhancement of programmes to satisfy the internal and external needs of institutions and individuals in responding to the wider health needs of society. Members have been able to learn from each other with regard to learning and teaching strategies, terminology, peer review, research influencing the curriculum, clinical placement and supervision and the effective use of

technological support in learning and teaching. The learning outcomes approach is an important area of discussion in the HENRE Tuning sub group. Quality enhancement activity is aimed at staff and others to improve student learning and improve the responsiveness of institutions to changes occurring in society.

Bibliography

The documents that are references for the subject area of Radiography are:

- The Quality Assurance Agency for Higher Education (2001) *Benchmark statement: Health care programmes – Radiography*.
- International Society of Radiographers and Radiological Technologists (1991) *Professional Standards for the Education of Radiographers*. London: ISRRT.
- International Society of Radiographers and Radiological Technologists (2004) *Guidelines for the Education Of Entry-level Professional Practice In Medical Radiation Sciences*. ISRRT, available at <http://www.isrrt.org/>, 18/04/2007
- Joint Quality Initiative (2004) Shared Dublin descriptors for the Bachelors, Masters and Doctoral awards, available at <http://www.jointquality.org/>,

A Bachelor in Radiological Sciences is able to:

Adapted from: The Quality Assurance Agency for Higher Education (2001) *Benchmark statement: Health care programmes – Radiography.*

Instrumental competencies

Skills for analysis and synthesis, organization, basic general culture, communication.

Identification and assessment of health and social care needs

The award holder should have demonstrated knowledge and understanding in a field of study that builds upon their general secondary education and is informed by knowledge at the forefront of their field of study. The practitioner will be able to:

- Gather relevant information from a wide range of sources including electronic data;
- Adopt systematic approaches to analysing and evaluating the information collected;
- Communicate effectively with the client/patient, (and his/her relatives/carers), group/community/population, about their health and social care needs;
- Use a range of assessment techniques appropriate to the situation and make provisional identification of relevant determinants of health and physical, psychological, social and cultural needs/problems;
- Recognise the place and contribution of his/her assessment within the total health care profile/package through effective communication with other members of the health and social care team.

Formulation of plans and strategies for meeting health and social care needs

The award holder should be able to:

- Work with the client/patient, (and his/her relatives/carers), group/community/population, to consider the range of activities that are appropriate/feasible/acceptable, including the possibility of referral to other members of the health and social care team and agencies;
- Plan care within the context of holistic health management and the contributions of others;
- Use reasoning and problem solving skills to make judgements/decisions in prioritising actions;
- Formulate specific management plans for meeting needs/problems, setting these within a timescale and taking account of finite resources;
- Record professional judgements and decisions taken;
- Synthesise theory and practice;
- Conduct appropriate activities skilfully and in accordance with best/evidence-based practice;
- Contribute to the promotion of social inclusion;
- Monitor and review the ongoing effectiveness of the planned activity;
- Involve client/patient/members of group/community/population

- appropriately in ongoing effectiveness of plan;
- Maintain records appropriately;
- Educate others to enable them to influence the health behaviour of individuals and groups;
- Motivate individuals or groups in order to improve awareness, learning and behaviour that contribute to healthy living;
- Recognise opportunities to influence health and social policy and practices.

Evaluation

The award holder should be able to:

- Measure and evaluate critically the outcomes of professional activities;
- Reflect on and review practice;
- Participate in audit and other quality assurance procedures;
- Contribute to risk management activities.

Interpersonal competencies

Skills for teamwork criticize and self-criticise, integrate multidisciplinary teams, understanding diversity and multi-cultural issues.

Professional autonomy and accountability of the radiographer

The award holder should be able to:

- Maintain the standards and requirements of professional and statutory regulatory bodies;
- Adhere to relevant codes of conduct;
- Understand the legal and ethical responsibilities of professional practice;
- Maintain the principles and practice of patient/client confidentiality;
- Practise in accordance with current legislation applicable to health care professionals;
- Exercise a professional duty of care to patients/clients/carers;
- Recognise the obligation to maintain fitness for practice and the need for continuing professional development;
- Contribute to the development and dissemination of evidence-based practice within professional contexts;
- Uphold the principles and practice of clinical governance.

Professional relationships of the radiographer

The award holder should be able to:

- Participate effectively in inter-professional and multi-agency approaches to health and social care where appropriate;
- Recognise professional scope of practice and make referrals where appropriate;
- Work, where appropriate, with other health and social care professionals and support staff and patients/clients/carers to maximise health outcomes;
- Maintain relationships with patients/clients/carers that are culturally

sensitive and respect their rights and special needs.

Personal and professional skills of the radiographer

The award holder should be able to:

- Demonstrate the ability to deliver quality patient/client-centred care;
- Practise in an anti-discriminatory, anti-oppressive manner;
- Draw upon appropriate knowledge and skills in order to make professional judgements, recognising the limits of his/her practice;
- Communicate effectively with patients/clients/carers and other relevant parties when providing care;
- Assist other health care professionals, support staff and patients/clients/carers in maximising health outcomes;
- Prioritise workload and manage time effectively;
- Engage in self-directed learning that promotes professional development;
- Practise with an appropriate degree of self-protection;
- Contribute to the well-being and safety of all people in the work place.

Profession and employer context

The award holder should be able to:

- Show an understanding of his/her role within health and social care services;
- Demonstrate an understanding of government policies for the provision of health and social care;
- Take responsibility for his/her own professional development;
- Recognise the value of research and other scholarly activity in relation to the development of the profession and of patient/client care.

Systemic competencies

Skills to apply theoretical knowledge in practice, to learn, adapt to new situations, generate new ideas, leadership, and autonomy.

Knowledge and understanding

The award holder should be able to:

- Understanding of the key concepts of the disciplines that underpin the education and training of all health care professionals, and detailed knowledge of some of these. The latter would include a broad understanding of:
 - The structure and function of the human body, together with a knowledge of dysfunction and pathology;
 - Health and social care philosophy and policy, and its translation into ethical and evidenced based practice;
 - The relevance of the social and psychological sciences to health and healthcare;
 - The role of health care practitioners in the promotion of health and

- health education;
- The legislation and professional and statutory codes of conduct that affect health and social care practice.

Skills

Capacity for reflection

The award holder should be able to:

- Critically appraise the science and practice of diagnostic radiography;
- Reflect on the potential and limitations of professional knowledge;
- Evaluate the impact of professional knowledge on practice.

Gathering and evaluating information and evidence

The award holder should be able to:

- Synthesis of knowledge and understanding of the scientific basis of diagnostic imaging and application to practice;
- Accurate analysis and processing of information and data in order to conduct examinations efficiently and effectively;
- Clinical reasoning based on judgements made from the verbal and physical presentation of an individual and information from a variety of sources including the referring practitioner; evaluation, in an appropriate and timely fashion, of the specific clinical situation encountered; and evaluative judgements of technical and clinical outcomes;
- Professional judgement skills in order to make informed, sensitive and ethically sound professional judgements and also to evaluate and interpret diagnostic images produced;
- Reflection on, and during, practice;
- The ability to think logically, systematically, and conceptually.

Problem solving

The award holder should be able to:

- Seek appropriate solutions to problems encountered in clinical practice in the light of relevant guidelines and evidence, the nature and presentation of the patient, and the location in which the examination is conducted;
- Analyse and process information and data accurately in order to conduct examinations efficiently and effectively;
- Sequence and adapt the radiographic process in the light of patient care needs, required clinical and radiographic outcomes, and available resources.

Practice

The award holder should be able to:

- Assess the patient's needs through interrogation of the clinical history in order to determine the precise nature of the examination to be conducted;
- Justify and match radiographic examination or imaging modality to clinical need, based on evaluation of evidence from professional or patient based sources;

- Prepare the patient, both physically and psychologically, in order to carry out an effective clinical examination;
- Position patients and clients accurately, safely and sensitively for examinations;
- Manipulate the range of technological equipment safely and efficiently;
- Generate and manipulate images (including verification of exposure factors) effectively and appropriately in relation to the pathology or trauma to be demonstrated;
- Evaluate and interpret images produced, making judgements about the acceptability of the quality of the images in the context of the patient's condition. This includes making judgements about the 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;
- Record and report findings appropriately;
- Apply effective moving and handling skills in order to protect patients and self from injury or further injury or, in the case of patients, further aggravation of an existing condition which could be concomitant with the reason for presentation. On occasion this will involve the movement of patients with severe trauma, acute pain and/or clinical shock and pre-existing physical deformity;
- Initiate resuscitation when necessary;
- Introduce contrast agents into the body when appropriate, including intravenous administration;
- Manage time effectively, including prioritisation of work load whilst delivering high quality care.

Communication and interpersonal

The award holder should be able to:

- Appropriate and effective inter- and intra-professional communication in written, oral and presentation formats;
- Effective supervision of students and other staff;
- Use of a wide range of information sources, for example, manufacturers' technical information and government policies and papers, in order to provide qualitative reports about the nature of the service, and trends and changes in the service;
- The integration of research and procedural data in order to produce reports contributing to effective patient management;
- The ability to collect and interrogate data relative to the performance of both the individual practitioner and the local service to monitor and influence practice.

Numeracy

The award holder should be able to:

- Confidence and competence in manipulating exposure parameters and variables in order to optimise dose and image quality considerations, according to the unique needs/interests of each patient and the examination

being undertaken;

- Numerical competence in determining doses required for contrast agents, analgesic and emergency drugs;
- Sufficient familiarity with, and competence in, manipulation of likely radiation doses and variables in order to advise/inform patients and referring clinicians of the relative risks arising from individual procedures;
- The ability to collect, interrogate, interpret and present relevant data from a range of sources and by a variety of methods;
- Arithmetical and statistical competence in order to interrogate data generated through audit and research.

Medical devices

The award holder should be able to:

- Confidence and competence in using the medical devices required for moving and handling patients, integrated into the diagnostic imaging and therapeutic process;
- Effective use of information communication technology in relation to information about or from patients, service management, teaching and learning, continuing professional development and research;
- Confidence and competence in utilising the extensive range of image generation, manipulation, display and recording devices used in radiographic and therapeutic practice.

Appendix TWO 1st cycle level ECTS (240 ECTS)

1Adapted from: International Society of Radiographers and Radiological Technologists (2004) *Guidelines for the Education Of Entry-level Professional Practice In Medical Radiation Sciences*. ISRRT

Scientific areas	ECTS
Basic sciences	90 ECTS (38%)
<p>Biomedical Sciences :</p> <p>Gives students an understanding of the structure, function and disease patterns of the human body. The courses should include anatomy, physiology, pathology and biochemistry.</p>	
<p>Physical Sciences:</p> <p>Provides students with the biomedical physics competences underpinning the scientific, effective, safe and efficient use of medical devices used in medical imaging and/or radiation therapy.</p>	
<p>Radiobiology:</p> <p>Gives students an understanding of cell biology in humans and the effects of ionizing and non-ionizing radiation on the human body.</p>	
<p>Statistics/mathematics:</p> <p>Mathematics forms the basis for an appreciation of scientific principles. A basic understanding of statistics and statistical analysis enables the student to understand and analyze data produced.</p>	
<p>Management :</p> <p>Provides the student with an understanding of management and organizational theory, and an opportunity to develop his knowledge and skills in the management process.</p>	
<p>Research:</p> <p>Provides the student with the opportunity to understand and use the elements involved in the research process.</p>	
<p>Healthcare sciences/Patient care/ethics:</p> <p>Provides students with an understanding of the concepts of patient care including</p>	

the patient's physical, social, cultural and psychological needs.
 In addition, the students will learn the principles of hospital acquired infection and their prevention.
 Students will also gain knowledge and understanding as well as experience of basic life support and emergency procedures.
 Students will gain a practical approach to ethical decision making with regard to health services users, colleagues and the wider population.

Broad radiography scientific area sciences	30 ECTS (12%)
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Radiation safety and protection

Provides the student with knowledge and understanding of radiation hazards and effects, dose optimization and radiation protection requirements for the staff, patient and the general public.
 In addition, students will gain knowledge of the relevant national and international directives and legislation, thus enabling effective application of appropriate protection.

Quality assurance

Provides the student with the understanding and skills necessary to evaluate the procedures and imaging/treatment systems thus ensuring the provision of effective, safe and efficient service to the patient, clinician, employer, and other members of the health care team.

Medical devices

This course provides an understanding of the operation and maintenance of all medical devices for professional purposes, thus enabling the student to competently use the devices.

Specific radiography scientific area sciences	90 ECTS (38%)
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Clinical education

Clinical education offered by a programme must be well integrated into and supported by the academic courses offered. The goal of every programme should be to bring each student to a point where they can deliver, in a consistent manner, patient care services within areas of demonstrated competence
 It is recognized that learning in practice-based settings is of equal value to that in the didactic setting. In the clinical setting, a student must, at all times, be

supervised by registered/accredited professionals and must be considered supernumerary to department personnel.

Radiological protocols

This course provides the student with the concepts and skills required to perform required procedures under a variety of conditions. Attention must be paid to the integration of the theoretical concepts and laboratory techniques with clinical applications.

Broad Scientific sciences

20 ECTS (8%)

Behavioural and Psychological sciences :

Provides knowledge and understanding of human development and behaviour from the birth to old age.

Communication:

These skills will enable the student to interact/function effectively in various situations.

Information technology

Provides the student with knowledge and understanding of computer and information technology and its application to radiography and the wider field

Electives

10 ECTS (4%)

Provides the student with an opportunity to pursue a particular interest at the institution or abroad.

Such electives may not necessarily be related to radiographic medical devices, e.g. computer languages, economics, philosophy, health and fitness courses, activities in the national society/students' union but must be weighted such that they form a very minor course requirement. (This list is by no means exhaustive and can be modified to suit the local conditions)

Appendix THREE

Based on the Dublin Descriptors¹ the Higher Education Network for radiographers in Europe (HENRE) Descriptors are as follows:

Original Shared 'Dublin' descriptors for First Cycle	HENRE Descriptors for 1st cycle awards in Radiography
Qualifications that signify completion of the first cycle are awarded to students who:	Qualifications that signify completion of the first cycle in Radiography are awarded to students who:
1. Have demonstrated knowledge and understanding in a field of study that builds upon and their general secondary education, and is typically at a level that, whilst supported by advanced textbooks, includes some aspects that will be informed by knowledge of the forefront of their field of study;	1. Have demonstrated skills, knowledge and understanding in the field of healthcare that build upon training undertaken within or concurrently with general secondary education, are typically at a level of advanced study and, in the principal study area of radiological sciences, are informed by the experience and knowledge of those at the forefront of their field;
2. Can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study;	2. Can apply their skills, knowledge and understanding in the field of radiological sciences in a manner that indicates a professional approach to their work, and have demonstrated competences as well as through devising and sustaining arguments and solving problems within their field of study;
3. Have the ability to gather and interpret relevant data (usually within their field of study) to inform judgements that include reflection on relevant social, scientific or ethical issues;	3. Have the ability to gather and interpret relevant data (usually within the field of healthcare and radiological sciences) to inform judgements within their professional activity that include reflection on practice and, where relevant, social, scientific or ethical issues;
4. Can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences;	4. Can communicate to others the understanding, ideas, information, problems and solutions to both specialist and non-specialist audiences;
5. Have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy.	5. Have developed those learning and practical skills that are necessary for them to continue to undertake further study with a high degree of autonomy.

¹. Available at www.jointquality.org

¹Joint Quality Initiative (2004) Shared 'Dublin' descriptors for Short Cycle, First Cycle, Second Cycle and Third Cycle Awards. Available at www.jointquality.org

Appendix 4 Generic Competences

1	A capacity for analysis and synthesis
2	A capacity for applying knowledge in practice
3	A capacity to reflect on experience in practice
4	An ability to plan and time manage one's own workload
5	Possess general knowledge in field of study
6	Possess a grounding of knowledge of the profession in practice
7	Be able to communicate orally and written in your native language
8	Possess knowledge of a second language
9	Possess an appropriate understanding of I.T. skills
10	Demonstration of an awareness of research and its use
11	Demonstration of a positive attitude to a responsibility for one's own learning
12	Demonstration of information management skills (ability to retrieve and analyse information from different sources)
13	Demonstration of critical and self critical capabilities
14	Demonstration of a capacity to adapt to new situations
15	Demonstration of a capacity to generate new ideas (creativity)
16	Demonstration of an ability to problem solve
17	Possess decision making skills
18	Demonstration of a command of interpersonal skills
19	Demonstration of initiative and leadership skills
20	Demonstration of team working skills
21	Be able to communicate with non-experts in the field
22	Be able to work in an international context
23	Respect the diversity of cultures and customs of other countries
24	Be able to work autonomously
25	Project design and management
26	Demonstrate an ethical commitment
27	Evaluation and maintenance of quality of work

Appendix 5 Subject Specific Competences

1	Work in a multidisciplinary health care team and effectively apply verbal and non-verbal communication with patients and others.
2	Inform and instruct patients appropriately before, during and after procedures.
3.	Document, communicate and report information in a coherent way while complying with data protection regulations.
4.	During the diagnostic or therapeutic procedure, apply ethical principles and obtain consent according to professional standards
5.	Practice according to national and local health and safety protocols
6.	Accept responsibility for one's own actions within the scope of professional practice.
7.	Evaluate the needs of patients in various circumstances and apply appropriate care.
8.	Strategically plan and manage one's own work load and work flow.
9.	Respond to patients clinical needs through appropriate application of diagnostic or therapeutic devices.
10.	Apply knowledge of medical physics, anatomy, physiology and pathology to the production of images
11.	Evaluate the process and result of a diagnostic or therapeutic procedure by relating the images produced to the anatomy, physiology and pathology demonstrated
12.	Demonstrate a knowledge of the different imaging techniques
13.	Recognise the need to adapt practice based on knowledge and experience in different contexts
14.	Demonstrate a holistic knowledge of radiations
15.	Optimise radiation dose management
16.	Acquire new diagnostic and therapeutic technological knowledge and demonstrate the ability to apply it to radiography
17.	Use appropriate diagnostic, therapeutic and ancillary devices effectively and safely
18.	Critically question radiological referrals in terms of analysis of risk and benefit
19.	Apply quality assurance techniques
20.	Apply an evidence base in the development of practice.
21.	Be involved in research and apply new developments within the scope of professional practice
22.	Demonstrate preparedness to undertake continuing professional development.
23.	Inform, instruct and supervise patients, staff and others
24.	Demonstrate an ability to practice in accordance with current legislation governing the use of medical radiation