# RECOMMENDED ESTRO CORE CURRICULUM FOR RADIATION ONCOLOGISTS/ RADIOTHERAPISTS

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## 1. Introduction

The European Society for Therapeutic Radiology and Oncology (ESTRO) developed in 1991 a "Minimum Curriculum for the Theoretical Education in Radiation Oncology in Europe". This document was endorsed by the national radiation oncology societies across Europe. The core curriculum was a great success and played a pivotal role in establishing comparable standards for training in radiotherapy all over Europe. In 2002 an update of the core curriculum was accepted by our community.

Medical education nowadays is based on competencies and consequently ESTRO decided to revise the core curriculum again, based on the principles of competency based training. These competencies are described for the roles of a physician indentified by the Canadian CANMEDS system (http://rcpsc.medical.org/canmeds/index.php). These roles involve:

1. Medical expertise
2. Communication
3. Collaboration
4. Knowledge and science
5. Health advocacy/Social actions
6. Management/Organisation
7. Professionalism

In the curriculum we distinguish competencies which can be considered as general competencies applicable to all aspects of the profession and those which are specific.

## 2. The role of radiation oncology in multidisciplinary approach of cancer treatment

*Definitions*

Radiotherapy (Radiation Oncology) is the branch of clinical medicine that uses ionising radiation, either alone or in combination with other modalities, for the treatment of patients with malignant or other diseases. It may be practiced as an independent oncological specialty or may be integrated in the broader practice of clinical oncology.

Radiotherapy (Radiation Oncology) includes responsibility for the diagnosis, treatment, follow up, and supportive care of the cancer patient, and forms an integral part of their multidisciplinary management and investigation.

In many countries this specialized area of medicine is at the present time recognised under the term 'radiation oncology'. In this document, however the double terminology 'radiotherapy/ radiation oncology' will be used since, as defined by the European Union of Medical Specialists (UEMS), radiation oncology excludes non-oncological treatment for benign disease whereas radiotherapy may also be used for the treatment of non-malignant conditions. In the present document "external beam radiotherapy" will encompass the various forms of delivery (2D, 3D, IMRT, stereotactic RT) and types of beams (photons, electrons and various particles).

Due to different national regulations, this curriculum primarily describes the knowledge and skills for the use of ionising rays and each national society should define the level and knowledge of skills necessary to contribute to combined modality treatment with systemic therapies in their country. It is recommended that all radiation oncologists should have at least a basic knowledge of medical oncology, being able to recognize and initiate treatment of medical oncology emergencies and taking clinical responsibility for the delivery of radiation therapy together with systemic agents.

*Training objectives*

The objective of the training programme is to educate and train physicians in the medical specialty of Radiotherapy (Radiation Oncology) up to the level of competency allowing them to practice as an independent specialist.

*Length of training*

The training period should be sufficient to obtain the competences to become an independent specialist. In general, the training period should be at least five years full time or if part-time, an equivalent period. At least 60% of the programme must be spent in clinical work.

*Responsibility for licensing*

Responsibility for licensing doctors to practice in Radiotherapy (Radiation Oncology) varies from one European country to another. Licensing should be based on objective assessment of completion of a training programme that fulfils the national guidelines.

## 3. Infrastructure and organisational aspects

*Training programme*

At the beginning of the training, the trainee should be presented with the curriculum and a written individual training programme. The training programme should describe the goals of the training, the time frame of each module and how the responsibilities for the training are distributed among the staff at the training institutions.

The training programme should correspond to the requirements outlined in the European core curriculum and to specific national requirements.

During the training the trainee should become gradually more responsible for patient care, with increasing autonomy and less dependent on supervision. A portfolio or logbook clearly documenting the clinical activities of the trainee (see page 7 and 28-29) is suggested as a tool to define the clinical responsibilities the trainee is authorized to undertake during the training.

*Training institutions*

If the minimum requirements for training institutions set in this core curriculum can not be met by a single institution, several training institutions should combine and offer an integrated programme that meets these minimal requirements. Licensing for training institutions or integrated programmes should depend on fulfilment of their national guidelines

*Radiotherapy (Radiation Oncology) resources in training institutions*

Training institutions must be accredited according to their national regulations. The training institutions, either alone or in cooperation with other regional departments, should be adequately

equipped to support both the workload and range of Radiotherapy (Radiation Oncology) services required for training including new technologies and novel techniques.

There should be megavoltage machines available, at least one with high-energy electrons, access to a dedicated CT-scanner, computerised treatment planning, a mould room and technical support. This should include appropriate dosimetry, radiotherapy protection equipment and appropriate patient treatment aids. Trainees should have an opportunity to become at least familiar with brachytherapy and IMRT. This can be organised by collaboration with institutions in which these treatments are concentrated. The department should have beds for inpatients or at least sufficient access to them in other departments. Teaching institutions should establish quality control programmes for patient care, treatment decisions, and outcome in a range of cancer sites.

To ensure adequate numbers and case-mix of patients, a minimum of 500 oncology patients should be irradiated yearly in the parent institution or the integrated programme. An adequate case mix for each trainee should be ensured by continuous monitoring by means of a portfolio or logbook.

Organisational aspects of patient care and practical teaching vary widely between European institutions. In some institutions the patient is followed by the trainee for the whole process from the first visit over treatment planning and applications to follow-up, whereas in other institutions trainees see patients for only part of the process. For part of their training period they will see only patients during their first presentation, during other periods they perform solely treatment planning, and in other periods, follow-up. For this reason the number of patients seen by a trainee is defined as the equivalent to a patient undergoing the complete process (full case equivalent). It is felt that the recommended number of full case equivalents seen by each trainee should be at least 450 during the total clinical Radiotherapy (Radiation Oncology) rotation. A trainee should not treat more than 250 full case equivalents per year to assure a good equilibrium between work load and the aims of the training.

*Staffing in training institutions (*(see also ttp://admin.uems.net/uploadedfiles/174.pdf)

*Programme director*

Each training institution or integrated programme should appoint a single programme director responsible for trainee education. It is considered preferable that the roles of programme director and chairman of the department are held by different people. The programme director is responsible for the general administration, the structure and the content of the programme. The programme director ensures that the programme fulfils the criteria in this core curriculum and the national requirements. The programme director must be a highly qualified radiation oncologist

with considerable experience in trainee education and in organisational activities. The programme director should organise regular documented meetings with the teaching staff to review programme goals and objectives, the programme effectiveness and future developments. At least one trainee representative should participate in these.

*Medical teaching staff*

Adequate staffing levels in the radiotherapy (radiation oncology) departments are essential for training. Several radiation oncologists/radiotherapists radiation oncologists responsible for teaching should be appointed. These teaching staff members need to devote a considerable proportion of their professional time to the teaching programme. It is preferable that the number of trainees does not exceed the number of full time equivalent staff radiation oncologists/radiotherapists. Sufficient supervision should be guaranteed.

*Physics teaching staff*

ESTRO has, in cooperation with the European Federation of Physics in Medicine (EFOMP), made recommendations previously on minimal staffing levels for the safe provision of a routine radiotherapy (radiation oncology) physics service (REF). Full time medical physics support must be available in teaching institutions. Medical physics staff members responsible for teaching should be appointed. Medical trainees should be taught dosimetry and the dosimetric aspects of treatment planning under the supervision of accredited medical physicist working in the field of radiotherapy, whereas the general principles of treatment planning should be learned under the clinical supervision of an experienced radiation oncologist. The trainees should also be familiar with the safety procedures and quality assurance in the training institution and the national regulations pertaining to these.

*(Radio) biology teaching staff*

Teaching institutions or integrated programmes should aim to have guaranteed access to a cancer biology laboratory and a chance to interact with its scientific staff. A minimum requirement is to provide training in radiobiology by formal accredited national and international courses.

***Other facilities and resources***

Adequate medical services must be available in medical oncology, surgical oncology and other oncology-related specialties and specific services. Access to current imaging techniques, pathology and clinical genetics, relevant to oncology should be available.

A sufficient variety of journals, reference books, and resource materials (or electronic equivalents) pertinent to radiotherapy (radiation oncology) and associated fields in oncology (basic sciences), and general medicine must be readily accessible for the trainee. The training institution should provide ready access to a computerised search system and rapid access to databases in medicine to permit literature reviews.

***Components of the education programme***

The training programme must provide the trainee with in-depth knowledge in the basic and clinical sciences in the field of radiotherapy (radiation oncology) and must train the trainee to be skilful in the clinical practice of radiotherapy (radiation oncology).

Training institutions or integrated programmes must schedule regular conferences (e.g. new patients, planning conferences, and problematic cases conferences), teaching rounds, case presentations and scheduled lectures. These teaching activities must include trainee participation that increases with experience.

Training institutions should facilitate access to teaching courses on a national or international level. These courses should attempt to put specific items of the European Core curriculum in an international perspective. These courses, like some ESTRO courses, should therefore be sufficiently wide-ranging to offer different point of views on the same subject, should facilitate interactions of trainees of different countries and circulation of radiation oncologists in Europe. These recommended teaching courses should be adapted according to the national requirements and the specific needs of the individual training programme. To add a European dimension to the education, it is also recommended that at least one teaching courses attended should be at a European level. A further recommendation is that during training each trainee participates in at least one international scientific meeting on radiotherapy (radiation oncology).

Teaching courses in radiation protection have to be provided according to national regulations.

Training institutions must allow the trainees sufficient protected time during their working hours for study of the literature, preparation of case presentation etc. It is suggested that on average a minimum of 10% of the weekly work time is appropriate. The remaining 90% of time should be mainly devoted to supervised and unsupervised clinical activities in appropriate proportions.

Trainees should actively participate in journal clubs and research conferences.

Trainees should be encouraged to engage in a research project under supervision of experienced staff (experimental research or clinical research).
Trainees should be encouraged to spend a period of their training in another institution (national or international) with an accredited teaching programme, which is accepted by the trainee's national society. These activities should also be recorded in the portfolio/logbook.

***Practical teaching sessions***

Member of the teaching staff should schedule regular practical teaching sessions with the trainees working directly under their supervision. During these sessions cases treated by the trainee should be reviewed. There should be a continuous feed-back to the trainees about their achievements in this specific field of training. It is felt that at least one practical training session between the teacher and the trainee should be scheduled per week (see page 28-9).

***Documentation of training experience***

Each trainee should keep a portfolio/logbook documenting his/her training experience. For this purpose a standardised European portfolio/logbook developed by ESTRO and UEMS covering this core curriculum has been developed. Use of this portfolio/logbook or a national equivalent which covers at least the items of the European Logbook is recommended. The programme director should review the portfolios/logbooks with the trainee at least twice yearly.

***Audit of teaching programmes***

Regular external audit of the training programme is recommended. Where no national audit system is established it is recommended that programmes request audit by the European Board of Radiotherapy Audit System endorsed by ESTRO and UEMS. As soon as some national education programmes have been audited, these programmes may audit the other national programmes.

***Further recommendations***

By analogy to the European law guaranteeing reciprocity in accepting professional diplomas in all member states, it is suggested that training periods undertaken by trainees according to the European Core curriculum in an accredited training programme in any member state should be accepted as equivalent to the same period of training in their own state.

It is recommended that the appropriate bodies in the European Union and the United States of America engage in negotiations on reciprocity in the acceptance of the residency training in Radiotherapy (Radiation oncology).

The European Core curriculum in Radiotherapy (Radiation Oncology) will be regularly reviewed and updated.

## 4. The Core Curriculum General Competencies

***Medical Expertise (see also specific competences in section 5)***

| Learning Outcomes | Knowledge | Skills/Expertise |
|---|---|---|
| **1. Able to relate knowledge of clinical and radiological anatomy, physics and biology to diagnosis and therapy** | Understand clinical and radiological anatomy | Able to identify landmarks, key structures including vessels, lymph nodes on CT and MRI<br>Able to interpret X-ray, CT, MRI and PET imaging<br>Able to apply knowledge of the biological and physics basis of RT to clinical practice |
| **2. Able to diagnose and stage cancer** | Understands the epidemiology and aetiology of the cancer<br>Knows the indications for urgent referral by family doctors/GP<br>Knows the staging systems and prognostic indices<br>Aware of the techniques available and limitations of histology and immunohisto-chemistry and other specialist techniques | Able to take a focused history and perform a focused examination<br>Able to recommended appropriate diagnostic and staging investigations |
| **3. Able to assess prognosis** | Knows the effect of performance status, stage, age, co-morbidity, histological type and other prognostic factors | Able to identify prognostic factors |
| **4. Able to assess if there is a significant genetic/ proteomic basis for the cancer** | Knows the features of the personal and family medical history that indicate a high risk of a genetic basis of the disease<br>Understands when referral for genetic counselling is appropriate<br>Knows how a gene abnormality affects the patient's prognosis | Able to take an accurate family history<br>Able to discuss the possibility of referral for genetic counselling with the patient<br>Able to explain to the patient how the treatment options may be altered by a genetic abnormality |

| Learning Outcomes | Knowledge | Skills/Expertise |
|---|---|---|
| **5. Able to discuss treatment options in the light of the prognosis** | Understands the indications for curative therapy and its side effects<br>Understands benefits and toxicity of palliative treatment | Able to inform patients on treatment options and discuss the individual risk/benefit and to elicit the patient's wishes with regard to the aims of treatment |
| **6. Able to develop an evidence based treatment strategy and to assess patients for curative and palliative external beam radiotherapy and brachy-therapy** | Understands the indications for treatment and the risks and benefits of different treatment options.<br>Aware of the results of major randomized trials that have influenced present practice<br>Aware of local, national and/or international guidelines | Able to take an appropriate history and perform and appropriate examination.<br>Able to develop a treatment plan based on own expertise and by discussions in the multidisciplinary teams |
| **7. Able to evaluate and synthesise research evidence to change practice** | Knows and can evaluate the published research evidence<br>Aware of and can evaluate ongoing trials of both radiotherapy and systemic therapy<br>Knows the national and international guidelines | Able to discuss evidence at MDT and contribute to guideline development<br>Able to discuss with colleagues involvement in clinical trials<br>Able to synthesise departmental, evidence based guidelines for the management of tumour sites<br>Able to introduce new treatments and techniques to a department |
| **8. Able to consent patients for radiotherapy** | Understands the acute and long term risks of radiotherapy, the aims of treatment and the prognosis | Able to communicate about these issues and risk/benefit ratio with patients<br>Able to take informed consent from patients and complete the form accurately |
| **9. Able to prescribe appropriate dose and fractionation schedule for curative and palliative external beam radiotherapy and brachy-therapy** | Knows dose/fractionation schedules in common use | Able to define appropriate treatment schedule according to stage of disease, performance status of patients and concomitant systemic therapy, knowledge relative to TV and OAR |

| Learning Outcomes | Knowledge | Skills/Expertise |
|---|---|---|
| **10. Able to develop a radio-therapy treatment strategy and technique** | Knows the radiotherapy modality and possible beam arrangements<br>Knows the patient position and immobilization technique<br>Knows the method of tumour localisation | Able to communicate effectively to the planning radiographers and physicists the imaging and treatment technique and document all aspects of the planning process clearly |
| **11. Able to determine the GTV, CTV, ITV, PTV, OAR and PRV as appropriate for external beam radiotherapy and brachytherapy** | Able to interpret diagnostic imaging (including CT, PET and MR)<br>Understands the use of cross-sectional imaging in planning<br>Understands the clinical and radiological parameters associated with planning 2D conventional and 3D conformal radiotherapy | Able to define a treatment volume<br>Able to define organs at risk and outline them<br>Able to define DVH based 3D conformal planning constraints |
| **12. Able to evaluate an external beam radiotherapy/brachy-therapy treatment plan in collaboration with physicists and radiographers and knowing the responsibilities of own and others actions** | Knows the ICRU guidelines for prescribing, reporting and recording dose<br>Knows the general process and workflow to achieve a treatment plan , treatment sessions and follow up (national or local recommendations) | Able to critically assess the dose distribution within the treatment volume and organs at risk<br>Able to identify whether a treatment plan is adequate and suggest ways of improving an inadequate plan<br>Able to take responsibility for the complete treatment plan |
| **13. Able to evaluate the risk of a EBRT/brachytherapy treatment plan** | Knowledge of the tolerance of the organs at risk and dose limitations | Able to critically assess the dose distribution within the treatment volume and organs at risk<br>Able to balance tumour control against potential damage to organs at risk |

| Learning Outcomes | Knowledge | Skills/Expertise |
|---|---|---|
| **14. Able to modify treatment plans according to patient's individual needs, pre-morbid conditions, toxicity of radiotherapy and systemic treatments etc.** | Aware of normal tissue morbidity and its impact on target volume definition<br>Understands risks of re-treatment with radiation based on normal tissue tolerance limits<br>Understands the type and severity of the toxicity added to radiotherapy by systemic treatments | Able to judge how to modify treatment plans based on patient's comorbidity and toxicity of systemic therapies<br>Able to assess when re-treatment is acceptable and prescribe appropriate dose and fractionation |
| **15. Able to participate in Quality assurance and follow safety policies** | Knowledge of the quality assurance procedures for the accelerators: measurements, required maintenance and levels of uncertainties accepted<br>Knowledge of the quality assurances procedures for treatment :level of tolerance accepted for set up margins, for TPS calculations and evaluations | Able to contribute to the quality assurance and general safety policies of the department |
| **16. Aware of the clinical implications of IMRT and of other techniques such as stereotactic and particle radiotherapy** | Can describe the theoretical benefits and risks of IMRT<br>Aware of the use of IMRT in different tumour sites<br>Aware of the need for quality assurance for IMRT and other techniques | Able to evaluate and give the final approval to an IMRT plan and –where available – to other plans such as those for stereotactic and particle radiotherapy |
| **17. Able to contribute to planning using IMRT and other techniques such as stereotactic, particle and IGRT** | Able to define, GTV, CTV and PTV as appropriate<br>Knows dose constraints for normal tissue | Able to draw the volumes of interest of a plan<br>Able to specify dose and tissue constraints for relevant organs |
| **18. Able to verify a radiotherapy treatment** | Aware of the techniques that are available to verify treatment plans | Able to assess accuracy of patient set-up and recommend adjustments |
| **19. Aware of the clinical implications of IGRT** | Understands the indications, aims and know the methods available | Able to assess accuracy of patient set-up and recommend adjustments |

| Learning Outcomes | Knowledge | Skills/Expertise |
|---|---|---|
| **20. Aware of the clinical implications and procedures of brachytherapy using sealed and unsealed sources** | Understands the indications and aims of treatment<br>Can describe the methods available<br>Able to describe the principles of dose prescription<br>Is aware of the radiation protection issues<br>Understands the acute and long term toxicities and can define the organs at risk | Able to practice the basic procedures of brachytherapy and to gain an operational knowledge of the specific techniques<br>Able to apply radiation protection principles when assessing patients receiving brachytherapy |
| **21. Able to assess and manage patients undergoing external beam radiotherapy and brachytherapy** | Understands early reactions to radiotherapy and their management | Able to assess and treat patients in an on-treatment clinic |
| **22. Be able to modify course of radiotherapy treatment for individual patients according to severity of reactions including adjustment for gaps in treatment** | Understands the radiobiology associated with curative radiotherapy | Able to modify course of radiotherapy treatment for individual patients |
| **23 Be able to assess patients for combined modality therapy** | Understands the circumstances in which this might be considered | Able to elicit the patient's wishes with regard to the aims of treatment<br>Able to discuss the side effects and risk/benefit ratio with patients |
| **24 Able to administer and take clinical responsibility for the delivery of radiation therapy together with systemic agents (and where necessary to work in collaboration with other medical specialists involved in systemic therapies ) on an in- or out-patient basis** | Understand the implications of systemic treatments | Able to modulate the treatment with drugs and radiation according to the patient situation – if needed, in collaboration with other specialists |
| **25. Able to consent patients for phase 2 and phase 3 trials trials and maintain appropriate research records** | Understand research ethics<br>Knowledge of Good Clinical Practice (GCP) and national laws related to research on human beings | Able to discuss options of entering a clinical trial |

| Learning Outcomes | Knowledge | Skills/Expertise |
|---|---|---|
| **26. Able to evaluate response of treatment and define follow-up plan** | Knowledge of patterns and time frame of relapse<br>Knowledge of RECIST and of the other common criteria for formalized response evaluation | Able to follow national/local guidelines or design a plan for follow-up<br>Able to use the appropriate methods for evaluating the response to treatment |
| **27. Able to diagnose suspected relapse** | Knowledge of signs and symptoms of relapse, tumour markers and appropriate imaging | Able to take an appropriate history and perform a focuses examination in out-patient clinics<br>Able to identify appropriate investigations for patients suspected of having relapsed<br>Able to interpret imaging (CT, MRI, PET) |
| **28. Able to develop a management plan for patients whose disease has relapsed alone or in collaboration with other specialists** | Aware of the role of surgery, interventional radiology, radiotherapy, chemotherapy, monoclonal antibodies, tyrosine kinase inhibitors, interferons, interleukins, symptom control and palliative care in patients with relapsed disease | Able to elicit the patient's wishes with regard to the aims of treatment and to give the treatment alone or in collaboration with other specialists |

*Communication*

| Learning Outcomes | Knowledge | Skills/Expertise |
|---|---|---|
| **1. Able to listen to and observe the patient and speaks clearly inlanguage that is easily understood** | Knowledge of the techniques of good communication and coping strategies | Able to listen and communicate clearly with patients independent of and taking into account their social, political, religious, cultural and sexual standpoint and reacts to body language, verbal and non-verbal signs, with relevant observations and questions |

| Learning Outcomes | Knowledge | Skills/Expertise |
|---|---|---|
| **2. Able to inform the patient, the family and other relevant people about the objectives, the process ,the risks including the possible side-effects of an investigation or Treatment** | Knowledge of the techniques of good communication and coping strategies | Able to give clear, objective information about standard treatments, randomised trials or experimental treatments. Can ascertain if the patient (or others) have understood the information and takes effective measures if this is not the case. |
| **3. Able to deliver bad news in a cautious and appro-priate way and discuss specific subjects: life with cancer, death, sexuality, acceptance processes etc.** | Knowledge of the techniques of good communication and coping strategies with people in crisis | Able to deliver bad news and discuss critical issues with patients and their relatives |
| **4. Able to build an appropriate therapeutic relationship with patients and their relatives** | Knowledge of the techniques of good communication and coping strategies | Able to empathise as much as possible with the situation of the patient, the relatives and other carers |

*Collaboration*

| Learning Outcome | Knowledge | Skills/Expertise |
|---|---|---|
| **1. Refers adequately and is available and accessible for patients, colleagues, referrers and others** | Know the structure of the healthcare system and how to manoeuvre within it | Able to recognise the need and refers patients appropriately for relevant treatments or social assistance<br>Able to show interest, through behaviour and attitude in the opinions of other professionals |
| **2. Can function in an onco-logy team, take a view and communicate it effectively** | Knows the responsibilities fo the different professional groups and is aware of the relevant multidisciplinary teams | Able to act in an oncology team and to confers appropriately with colleagues, medical physicists, radiotherapy technicians and other care workers |

| Learning Outcome | Knowledge | Skills/Expertise |
|---|---|---|
| **3. Able to take part in discussions in multi-disciplinary teams and to secure effective interdisciplinary collaboration to provide seamless care** | Understands the indications for treatments and the risks and benefits of different treatment options | Able to deliver effective interdisciplinary consultations and to contribute effectively in the discussions in multidisciplinary teams |
| **4. Able to impart knowledge to other doctors, students, other assistant personnel and patients** | Knowledge of how to teach and share knowledge with other colleagues and other assistant personnel, patients and relatives | Able to impart knowledge and assess that learning has occurred |
| **5. Shares knowledge with radiotherapy and other oncology colleagues to guarantee that patient health care is given in the most effective way** | | Able to work in a multidisciplinary organisation and able to make concessions if this means achieving a consensus |
| **6. Helps colleagues, offers help** | | Able to behave in a way that produces an optimal working environment |

*Knowledge and science*

| Learning Outcomes | Knowledge | Skills/Expertise |
|---|---|---|
| **1. Examines medical information critically** | Knowledge of statistics, critical reading, methodology | Able to read scientific and popular literature and to extract the message and critically review it. |
| **2. Broadens and develops scientific expertise** | Aware of methods os updating knowledge e,g,m regular literatures studies, conferences and courses | Actively responsible for own continuous medical education and development and maintains a personal continuing education plan |

| Learning Outcomes | Knowledge | Skills/Expertise |
|---|---|---|
| **3. Shares expertise with students, colleagues, patients and others involved in health care** | | Able to educate and encourage other health care personnel or patients to reach a higher level of knowledge |
| **4. Participate in investigations based on a clear research plan with attention to time investment, duration, cost and other necessary resources** | Participate in the activities of multidisciplinary research groups, scientific groups and other networks | Able to contribute to planning, conducting, finishing and presenting research projects. Constantly try to optimise the time from the beginning of an investigation to the results and publication |
| **5. Builds, maintains or participates in good national and international research networks** | Participate in the activities of multidisciplinary research groups, scientific groups and other networks | Able to build and maintain national and preferably international networks during participation in multidisciplinary teams, scientific societies and other types of networks |
| **6. Recognizes the implications of the research on daily practice** | Knowledge of scientific publications | Contributes to the implementation of research results |
| **7. Is aware of the process of publishing and presenting scientific results** | Is aware of the rules and methodologies of publishing and presenting | |

***Health advocacy/Social actions***

| *Learning Outcomes* | *Knowledge* | *Skills/Expertise* |
|---|---|---|
| **1. Integrates the different aspects of supportive care and treatments that have a positive effect on the well-being of the patient to provide holistic care** | Knowledge of the legal aspects of health care and the services available for the care of cancer patients | Able to coordinate the therapeutic and support services relevant for cancer patients |

| *Learning Outcomes* | *Knowledge* | *Skills/Expertise* |
|---|---|---|
| **2. Acts within the legal framework** | Knowledge of the legal aspects of health care and the rights of the patient to factual information | Acts in accordance with national health regulations and national law |
| **3. Takes adequate action in response to incidents and adverse effects occurring during care** | Knowledge of national guidelines, law and regulations regarding adverse incidents occurring during care | Able to take adequate actions according to national law and health regulations |
| **4. Advises the patient of necessary changes in lifestyle and behaviour as a result of the previous treatment and the present medication** | Knowledge of effects and side effects of anti-neoplastic drugs and other medication | Able to advise the patient of relevant changes in behaviour and lifestyle to cope with the effects of treatment |
| **5. Advises the patient of necessary changes in lifestyle and behaviour to reduce the risk of developing further cancers** | Knowledge of the aetiology of the various cancer types | Able to advise the patient of relevant changes in behaviour and lifestyle to reduce the risk of developing further cancers |
| **6. Shows consideration for other person's ethical, religious, cultural or moral problems and standpoints** | Aware of cultural and religious viewpoints that may impact on the treatment of cancer | Able to show understanding for divergent standpoints and customs |

***Management/ Organisation***

| **Learning Outcomes** | **Knowledge** | **Skills/Expertise** |
|---|---|---|
| **1. Organises work to achieve a balance between patient care and personal development** | Knowledge of time management | Able to divide professional time between patient care and personal development including reserving time for reading and keeping abreast of current medical and radiotherapy literature |

| Learning Outcomes | Knowledge | Skills/Expertise |
|---|---|---|
| **2. Works effectively and practically within a health care organisation** | Know the structure of the healthcare system and how to manoeuvre within it | Able to use professional time optimally by establishing priorities and developing and following a plan. Realises that effective use of time is dependent on planning and punctuality. Able to develop efficiency and accuracy in clinical skills |
| **3. Spends available resources for patient care sensibly** | Knowledge of the costs of healthcare and understands the cost-benefit of different therapies | Able to use available resources carefully considering goals, costs and realistic benefits. This includes the ability to set up a realistic plan of action and assign the required resources, time and people |
| **4. Uses information technology for optimal patient care and for continuing education** | Knowledge of how to use available information technology as effectively as possible | Able to use available systems for patient care, research and communication |
| **5. Creates and maintains complete and accurate medical files for every patient that is seen** | Knowledge of national law and regulations for maintaining medical files and other patient data | Able to maintain medical files and data according to national law and regulations |
| **6. Organises and supervises the younger doctors and medical students in the clinical and/or in the out-patients department in such a way that the efficiency and effectiveness of the patient's care is guaranteed** | Knowledge of the structure of the department and the health care system on a local, regional and national basis | Able to organise the daily work in a department and to coordinate the work with other departments – i.e. conferences with the multidisciplinary teams etc. Able to organise the work in a way that younger doctors always have access to help from senior colleagues |
| **7. Recognises where an important role can be played by patient organisations in respect of patient (and/or family) help, and makes help available if so desired** | Knowledge of the regional and national patient- and healthcare organisations | Able to inform the patient of relevant organisations and how they may be of interest to the patient |

*Professionalism*

| Learning Outcomes | Knowledge | Skills/Expertise |
|---|---|---|
| **1. Demonstrates ethical values in relation to illness and health, life and death and is aware of own standards and values and how these influence one's professional practice and performance** | | Aware of own standards and values and know how to deal with them in the daily work and according to ethical standards and understand concepts such as respect, responsibility, rights, obligations, privacy, trust, autonomy and paternalism |
| **2.Copes with own emotions and criticism** | | Able to look critically at own actions and opinions |
| **3. Displays appropriate behaviour** | | |
| **4. Knows own competency limitations and works within them** | | Able to seek information and help from other colleagues whenever needed. Takes responsibility for own actions |
| **5. Take into consideration the patient's gender, age, culture, educational level and life philosophy when dealing with the patient and treats with care the trust that patients and those seeking help put in the health service** | Knowledge of the mechanisms of good communication | Able to listen and communicate with patients independent of their social, political, religious and sexual standpoint and reacts to body language, verbal and non-verbal signs, with relevant observations and questions<br>Shows understanding for divergent standpoints and are able to show consideration for the patients ethical and moral problems |
| **6. Informs the patient on request on the laws on the protection of privacy** | Awareness of the national laws and regulations for maintaining medical files and other patient data | Able to give the correct information to patients |
| **7. Works consistently according to professional codes** | Aware of the professional code of the national society in the country | Able work accordingly to the professional code and does not misuse power or authority, or knowledge of personal information |

## 5. The core curriculum - specific competencies

### *5.1 Basic Sciences*

Each trainee should during the training period achieve competences as indicated by Bloom's classification in the listed topics and items of basic sciences related to radiation oncology. In many cases teaching in these subjects will be performed in formal national or international teaching courses. Examples of a modular curriculum are the basic teaching courses offered by the European Society of Therapeutic Radiology and Oncology (Radiobiology, Molecular Oncology, Physics, Evidence Based Radiation Oncology, Brachytherapy, Imaging for Target Volume Determination).

The indications of levels presented here by ESTRO should be considered as minimum competencies for all countries and the national societies can therefore define if upgrading is more appropriate for the national situation.

The competences have been expressed employing Bloom's classification (Bloom,, B.S., Englehart, M.D., Furst, E.,J., Hill, W. and Krathwohl, D (1956) *Taxonomy of educational objectives. Vol 1: The cognitive domain.* New York: McKay). Bloom recognised that there was an ascending order of thinking behaviours from factual recall to analysis and evaluation. He suggested verbs that may be associated with the different levels in this proposed hierarchy of the cognitive domain although the same verb may be used for different levels. This list has been extended by various authors. Kennedy et al (2009) (Kennedy, D. Hyland A. & Ryan, N (2009). *Writing and using learning outcomes: a practical guide*.

http://www.bologna-handbook.com/docs/downloads/C_3_4_1.pdf provide a practical guide to understanding and linking such learning outcomes to teaching and assessment. They define the different levels of cognitive behaviour as follows:

- Knowledge – the ability to recall or remember facts
- Comprehension - the ability to understand and interpret learned information
- Application - the ability to use learned material in new situations e.g. put ideas and problems to work in solving problems
- Analysis – the ability to break down the information into its components e.g. look for inter-relationships and ideas
- Synthesis - the ability to put parts together
- Evaluate - the ability to judge the value of material for a given purpose

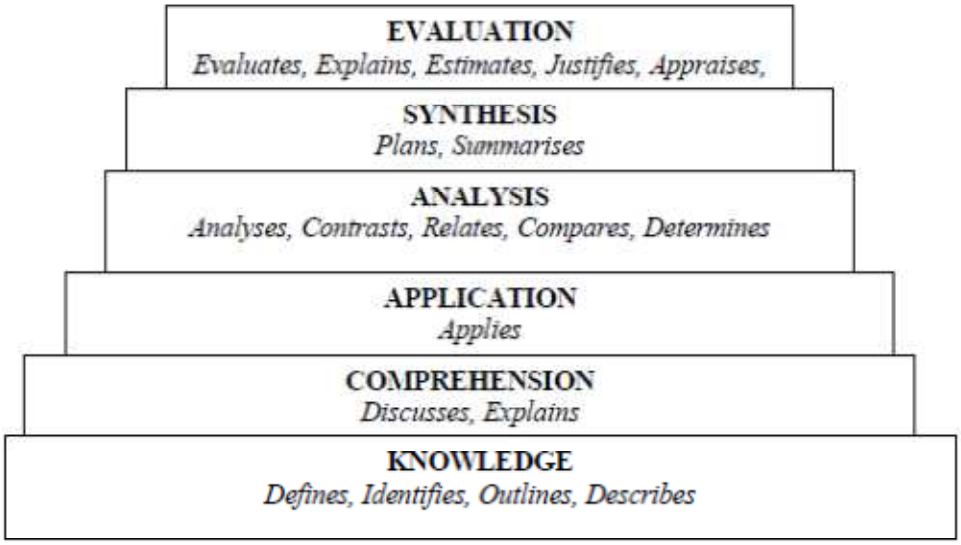


Fig 1 – Hierarchy of the cognitive domain

The level at which the trainee is expected to interact with the information is listed in brackets after each statement.

**Biology of cancer**

Defines the terminology and outlines the techniques of molecular biology (knowledge)

Describes hereditary cancer syndromes and relates these to the underlying genetic abnormalities (knowledge)

Describes Cancer genetics (knowledge)

Discusses Proliferation, cell cycle and cell death in cancer (comprehension)

Discusses Signal transduction (comprehension)

Explains the importance of genome maintenance mechanisms for preventing cancer (comprehension)

Describes the microenvironment of the tumour-host interface (knowledge)

**Biological and targeted treatments**

Explains the mechanism of action of targeted drugs, antibodies, tyrosinekinases etc. (comprehension)

Explains the mechanism of action of immunotherapy (comprehension)

Explains the mechanism of action of Cancer vaccines (comprehension)

Explains the mechanism of action of Gene therapy (comprehension)

**Radiobiology**

Describes the interaction of radiation on molecular level (knowledge)

Discusses DNA damage (comprehension)

Describes cellular effects, mechanisms of cell death (knowledge)

Describes repair of radiation damage (knowledge)

Discusses cell survival curves (comprehension)

Describes normal tissue systems (knowledge)

Describes solid tumour and leukaemia systems (knowledge)

Explains effects of oxygen, sensitizers and protectors (comprehension)

Explains the effect of time-dose-fractionation, LET, and different radiation modalities and evaluate their role in clinical practice (evaluation)

Compares acute and late normal tissue reactions (analysis)

Discusses Tumour responses (comprehension)

Discusses the interaction between cytotoxic therapy and radiation (comprehension)

Outlines predictive assays (knowledge)

**Basic radiation physics**

Describes atomic and nuclear structure (knowledge)

Describes radioactive decay (knowledge)

Contrasts the properties of particle and electromagnetic radiation (analysis)

Defines and describes radioisotopes (knowledge)

**Radiation physics applied in radiation therapy (RT)**

Outlines the design and explains the mechanism of action of an X-ray tube (comprehension)

Describes the design and explains the mechanism of action of a linear accelerators (comprehension)

Describes specialized collimating systems (knowledge)

Describes brachytherapy systems (knowledge)

Outlines the design and explains the mechanism of action of a cyclotron (comprehension)

Defines, explains and discusses absorbed dose distributions (comprehension)

Describes treatment planning including 3D planning, virtual and CT simulation and applies these procedures to plan patients' treatments (application)

Evaluates the benefits of conformal and special radiotherapy techniques (IORT, stereotactic radiotherapy) (evaluation)

Defines target absorbed dose specification in external RT knowledge)

Defines target absorbed dose specification in brachytherapy (knowledge)
Applies algorithms for 2D dose calculations (application)
Outlines algorithms for 3D dose calculations (knowledge)
Outlines the principles, explains the technical aspects and discusses the applications of conformal RT, IMRT, IGRT, stereotactic RT and particle therapy (comprehension)

**Radioprotection**

Discusses the general philosophy of radioprotection including ALARA (comprehension)
Contrasts stochastic and deterministic effects (analysis)
Discusses the risk of induction of secondary tumours (comprehension)
Defines and discusses radiation weighting factor (knowledge)
Defines and discusses equivalent dose – tissue weighting factor (comprehension)
Discusses occupational/public health consequences of radiation exposure, radioprotection and dose limits for occupational and public exposure (comprehension)
Outlines European and national legislation (knowledge)
Determines what is evidence based in radioprotection (knowledge)

**Clinical research and measurement of treatment outcome**

Defines and evaluates measurements of tumour control and toxicity (evaluation)
Discusses and appraises study design (evaluation)
Describes different types of trials and summarises their roles knowledge
Performs life-table analysis (application)
Identifies test of significance (knowledge)
Compares univariate/multivariate analysis (analysis)

**Specificity/sensitivity/validity/power**

Outlines meta-analysis and explains its importance (comprehension)
Discusses levels of evidence (comprehension)
Identifies pitfalls: pilot studies, preliminary results, stage migration, fraud (knowledge)

**Basic Management and Economics of radiation therapy**

Discusses how to define work load (comprehension)
Predicts and justifies the need for radiotherapy (evaluation)
Estimates the cost (evaluation)
Describes reimbursement systems (knowledge)

### *5.2 Clinical Curriculum – specific competencies*

**Objectives**

Specialists in radiotherapy/radiation oncology shall be able to act independently or as a *responsible* member of a (multidisciplinary) team.

Recognise symptoms and signs of cancer

- Make a diagnostic programme for suspected tumours or metastases and perform staging and classification of manifested tumours
- Perform prognostic assessment, define the treatment aim, choose the radiation modality (or interdisciplinary modality), plan and apply optimal radiation therapy and combined drug and radiation treatment and do the follow up during and after treatment
- Perform supportive care / symptomatic treatment and terminal care
- Diagnose, score and treat side effects of radiation therapy
- Assess the impact of radiation oncology on quality of life
- Communicate adequately and accurately to cancer patients
- Manage common psychological reactions to crises and final stage of life
- Practise medicine in accordance with medical ethics and patient rights

Specialists in radiotherapy/radiation oncology shall be well versed and have knowledge of

Epidemiology of cancer

- Cancer prevention, screening, early detection and education to the public
- Tumour pathology, tumour cytology and tumour classification
- Treatment with surgery, chemotherapy, endocrine therapy, other forms of treatment and combined modalities
- The structure/organisation of oncology services

**Specific organs and/or disease**

Each trainee should during the training period acquire in depth knowledge and skills (level 2) of the majority of tumours mentioned in the list below. However, some tumour types can be considered as less frequent or rare and should primarily be treated at specialised centres. For these tumour types a clear knowledge (level 1) of diagnostic and therapeutic possibilities is vital for properly referral of the patient to a more specialised institution when needed.

The indications of levels presented here by ESTRO should be considered as minimum competencies for all countries. Each country can however, on a national basis (national epidemiology) adopt different levels for the different items.

*Head & Neck (2)*

- Glottic and supraglottic larynx
- Oral cavity
- Nasopharynx
- Oropharynx
- Hypopharynx
- Lips
- Nose
- Paranasal sinuses
- Salivary glands
- Thyroid gland
- Ear
- Others

*Gastrointestinal (GI) Tract (2)*

- Oesophagus
- Stomach
- Small bowel
- Colon/rectum
- Anus
- Biliary tract
- Liver
- Pancreas

*Lung/Mediastinum (2)*

- Non-small cell lung cancer
- Small cell lung cancer
- Mediastinal tumours
- Mesothelioma
- Thymoma

*Bone & Soft Tissue (2)*

*Skin (2)*

- Melanoma
- Non-melanoma

*Breast (2)*

*Gynaecology (2)*

- Cervix
- Endometrium
- Ovaries and fallopian tubes
- Vagina
- Vulva

*Genitourinary (GU) Tract (2)*

- Prostate
- Bladder

- Testes/seminoma
- Testes/nonseminoma
- Kidneys
- Ureter
- Urethra
- Penis

*Ophthalmic/Orbital tumours (1)*

*Lymphomas & Leukemias (2)*

- Hodgkins's disease
- Non-Hodgkin's lymphoma
- Leukaemia
- Multiple myeloma and/or plasmacytoma
- Total body irradiation
- Total skin irradiation

*Central Nervous System (2)*

- Glioma's
- Meningioma's
- Spinal cord
- Base of skull
- Others

*Unknown primary (2)*

*Palliation (2)*

- Skeletal metastases
- Brain metastases
- Cord compression
- Vena cava syndrome
- Obstruction disease
- Bleeding syndromes

*Retreatment (2)*

*Paediatrics (1)*

*Benign disease (1)*

- Benign tumours
- Benign diseases

**6. Assessment**

Evaluation of competencies is an ongoing process taking place from the very start of training and therefore in many ways is different from the classical examination. When evaluating competencies it is often necessary to have a variety of tools that can be used regularly and it is recommended that several evaluators assess the trainee in order to get an objective and "true" picture of the trainee's skills as possible.

When evaluating competencies one must bear in mind that "scoring" of competencies is probably of minor importance and it is often more important to discuss the assessment with the trainee in order to secure progress in knowledge and skills.

It is realised that assessment of competences can be done in many ways and each country should decide on criteria that determine successful training or failure. The list below describes possible methods that could be gradually integrated in departments to evaluate trainees. It is up to the national societies and/or authorities to decide which methods should be used. ESTRO wishes to follow the development of and experience gained with the different assessment tools and will obtain an update of this information for future editions of the core curriculum.

### *6.1 Testing*

*Starting points*

Regular testing takes place in order to evaluate whether the resident in training satisfies the required competencies, and as support for the learning process. The resident in training is tested throughout the duration of the training.

*Local*

The resident in training is tested by the local trainers on a regular basis.
Possible tools for evaluation are feedback at the work place, 360 degree feedback, workplace assessment/mini-CEX (Clinical Examination eXercise), the portfolio, the logbook and the progress interview.

- **Feedback in the workplace**

These are the continuous daily interactions between the tutor and resident in the framework of patient care. In the course of these interactions, a picture of the resident in training is formed that is formalized on a competency card. At least one practical training session should be scheduled each week (see page 7).

- **Workplace-assessment/mini-CEX**

Workplace assessment is a form that can be used when observing the resident in training carrying out actions in practice. It could be skills like physical examination, a bad-news conversation, surgery, taking a patient history, giving a paper, etc. Various competency fields for which the resident in training can be assessed are mentioned on the form.

Usually a member of staff announces beforehand that a particular occasion will be used for, this type of assessment, but the resident in training can also make arrangements for this, and it can also take place without prior notice. The member of staff will carry out an observation and give

feedback on it directly afterwards. In total this need not to take more than 15-20 minutes, including feedback.

• **360 degree feedback**

For this form of assessment, a structured evaluation of the resident in training takes place by members of staff and/or fellow residents in training. The form of assessment applies especially but not only to the Communication and Collaboration competency fields. It could be substituted by a non-structured evaluation obtained under the responsibility of the programme director.

• **Portfolio**

The portfolio is a document collection kept by the resident in training in which the following items are kept during the duration of the training. The resident in training keeps the portfolio up-to-date himself and regularly reflects, with others in training and with his tutor (s), upon his competency development.

1. Personal details
2. The instruction model
3. Training schedule
4. Evaluations and reports of assessment interviews by the tutor undertaken in accordance with national guidelines
5. Workplace-assessment sheets/mini-CEX
6. Possibly competency card modules with report of progress interviews by the tutor
7. Possibly report of 360 degree observation
8. Results of tests and examinations that are part of the postgraduate medical course
9. Submitted papers
10. Publications, articles, abstracts, poster
11. Attended conferences, courses, reference meetings, scientific meetings
12. Special activities or reflections on significant incidents and the learning gained from these
13. Tutor declaration regarding the completeness and accuracy of the portfolio

• **Logbook**

The review of the logbook content by the programme director (scheduled at least twice yearly) should be considered a form of assessment. It also allows definition of the clinical responsibilities the trainee can assume independently during the following period of training.

• **Progress interview**

These interviews take place between the resident in training, the tutor and the substitute tutor. These interviews are planned in the schedule beforehand.

**List of abbreviations:**

2D 2 dimensional radiotherapy
3D 3 dimensional radiotherapy
ALARA "As Low (dose) As Reasonable Applicable"
CANMED Canadian Medical Society
CT Computed Tomography
CTV Clinical Target Volume
DVH Dose Volume Histogram
EBRT External Beam Radiotherapy
EFOMP European Federation of Physics in Medicine
ESTRO The European Society for Therapeutic Radiology and Oncology
GCP Good Clinical Practice
GI Gastrointestinal
GTV Gross Target Volume
ICRU International Commission on Radiation Units and measurements
IGRT Image guided Radiotherapy
IMRT Intensity Modulated Radiotherapy
IORT Intra Operative Radiotherapy
ITV Internal Target Volume
LET Linear Energy Transfer
Mini-CEX mini Clinical Examination eXercise
MRI Magnetic Resonance Imaging
MDT Multi-Disciplinary Team
OAR Organ At Risk
PET Positron Emission Tomography
PRV Planning Risk Volume
PTV Planning Target Volume
QA Quality Assurrance
RT Radiotherapy
TPS Treatment Planning System
TV Target Volume
UEMS European Union of Medical Specialists