

Updated European Core Curriculum for Radiotherapists
(Radiation Oncologists)
**Recommended Curriculum for the Specialist Training of Medical
Practitioners in Radiotherapy (Radiation Oncology) within Europe**

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1. INTRODUCTION

1.1 Background

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. After more than 10 years, it became important to update the core curriculum and to proceed on the way to harmonisation of training in radiotherapy in Europe, as more and more colleagues, based on the right of mobility guaranteed to them by European law [2], are prepared to work in countries where they have not been educated.

With a mandate from the European Society for Therapeutic Radiology and Oncology (ESTRO) and the European Board of Radiotherapy (EBR), a European Core Curriculum Working Party was formed. The work of this group was in part financially supported by the European Commission under the Europe Against Cancer Programme. During a series of meetings over the last years, the working party updated the Core Curriculum in light of new developments in the field of radiotherapy and under thorough consideration of the different national guidelines on

training programmes in radiotherapy in an expanding Europe. Trainees from different European countries advised the members of the Core Curriculum Working Party. Special efforts were also made to harmonise the European Core Curriculum with the Programme Requirements for Residency Education in Radiation Oncology issued by The American Board of Radiology [1] to support negotiations between the appropriate bodies in the European Union and the United States of America on reciprocity of accepting resident training programmes. Where the 1991 edition was a "Minimum Core Curriculum" [4], the new version is much more detailed and also includes new recommendations on organisational and infrastructural aspects that are based on the updated UEMS Charter for radiotherapy [6].

In the summer of 2002, the final draft of the curriculum was circulated to all national scientific radiotherapy societies and professional radiotherapy bodies within Europe for consideration and approval. On 14 December 2002 representatives of these societies and bodies were invited to a meeting in Brussels to discuss the updated curriculum. All representatives from 35 European countries who attended the conference (table 1) endorsed the new standards and thereby paved the way for further improvement and harmonisation of the quality of training of medical specialists in the field of radiotherapy (radiation oncology) across Europe. The responsibility for the implementation of the standards and guidelines set in the updated Core Curriculum for radiotherapy (radiation oncology) will lie with the local and/or national training bodies and authorities.

1.2 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.

Radiotherapy (Radiation Oncology) can be practised as an independent oncological speciality or it may be integrated into the broader medical practice of oncology.

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

In many countries this specialised area of medicine is at the present time recognised under the term 'radiation oncology'. However, in this document 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.

1.3 Training Objectives

The objective of the training programme is to educate and train physicians in the medical speciality of Radiotherapy (Radiation Oncology) up to the level of being recognised as an independent specialist.

1.4 Length of training

The training period should be 5 years full time or if part-time, an equivalent period. Not less than 60% of the programme must be spent in the clinical work included in the core curriculum of Radiotherapy (Radiation Oncology).

1.5 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.

2. INFRASTRUCTURE AND ORGANISATIONAL ASPECTS

2.1 Training programme

The curriculum, structure, time frame, distribution of responsibilities, and goals of each individual training programme should be outlined in writing at the beginning of the programme or at the start of each module. The programme should correspond to the requirements outlined in this European core curriculum and to specific national requirements.

2.2 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.

2.3 Radiotherapy (Radiation Oncology) resources in training institutions

Training institutions must be accredited according to their national regulations. The training institutions either alone or in co-operation with other regional departments should be adequately equipped to support both the workload and range of Radiotherapy (Radiation Oncology) services required for training. This includes treatment units, simulators, treatment planning systems, access to CT scanning and other imaging facilities, computing facilities, appropriate dosimetry and radiation protection equipment, appropriate patient treatment aids.

There should be megavoltage machines available, at least one with high-energy electrons, a simulator, computerised treatment planning and a mould room or machine shop. Equipment for interstitial and intracavitary brachytherapy should be available at least for gynaecological indications and a kilovoltage capability (or appropriate brachytherapy equipment) is desirable for skin tumours. The department should have beds for inpatients or at least access to them in other departments. Teaching institutions should establish quality control programmes for patient care, treatment decisions, and outcome in different diseases.

To ensure adequate numbers and case-mix of patients, a minimum of 500 oncological patients should be irradiated yearly in the parent institution or the integrated programme. An adequate case mix for each trainee should be continuously monitored by means of a log-book [3]

Organisational aspects of patient care and practical teaching vary widely between European Institutions. In some institutions the patient is followed by the trainee from the first visit over treatment planning and application to follow-up whereas in other institutions trainees see for some part of their training period only patients during their first presentation, during other periods they perform solely treatment planning, and in other periods again follow-up. For this reason the number of patients seen by a trainee was defined as the equivalent to a patient completely treated from the first visit into follow-up (full case equivalent). (It was 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) rotations. A trainee should not treat more than 250 full case equivalents per year).

2.4 Staffing in training institutions

Programme director

Each training institution or integrated programme should appoint a single programme director responsible for the trainee education. It is considered preferable that the programme director is not identical with the chairman of the department.-The programme director is responsible for the general administration of the programme, the structure and the content of the programme. The programme director ensures that the programme fulfils the criteria set in this core curriculum and by 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 [5]. Several radiotherapists (radiation oncologists) responsible for teaching should be appointed. These teaching staff members need to devote a considerable portion of their professional time to the teaching programme. The number of trainees should not exceed the number of full time equivalent staff radiotherapists (radiation oncologists).

Physics teaching staff

ESTRO has, in cooperation with the European Federation of Physics in Medicine (EFOMP), previously made recommendations 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 how to participate in treatment planning under the supervision of accredited medical physics experts.

(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. In view of the current lack of radiobiologists within radiotherapy (radiation oncology) departments in many European states, a minimum requirement is to provide training in radiobiology by formal accredited national and international courses.

The staffing requirements for teaching should be reviewed within a period of 5 years.

2.5 Other facilities and resources

Adequate medical services must be available in the specialties haematology/medical oncology, surgical oncology, gynaecological oncology and other specific oncological services (e.g. head and neck, paediatric oncology, urology, etc.) Access to current imaging techniques, nuclear medicine and pathology 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 trainee study. The training institution should provide ready access to a computerised search system and rapid access databases in medicine to permit literature reviews.

2.6 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). The minimum basic science and clinical curriculum is listed under 3.

Training institutions or integrated programmes must schedule regular conferences (e.g. new patients, planning conferences, problematic cases conferences), teaching rounds, case presentations and scheduled lectures. These teaching activities must provide for progressive trainee participation.

Training institutions should provide access to teaching courses on a national or international level. These courses should attempt to cover the European Core Curriculum to the depth achieved in the relevant ESTRO courses. This curriculum of 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 recommended that at least two teaching courses should be attended at a European level. It is further recommended that during training each trainee participates actively in at least one European 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 10% of the weekly work time is appropriate.

Trainees should actively participate in journal clubs and research conferences.

Trainees should be encouraged to engage in an investigative 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 .

2.7 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 of their achievements in the specific field of training. It was felt that at least one practical training session between the teacher and the trainee should be scheduled per week.

2.8 Documentation of training experience

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

2.9 Audit of teaching programmes

Regular external audit of the training programme is recommended. Where no national audit system is established it is recommended to ask for audit by the European Board of Radiotherapy Audit System currently under development. As soon as some national education programmes have been audited, these programmes may audit the other national programmes (snow-ball-effect).

2.10 Further recommendations

By analogy to the European law guaranteeing reciprocity in accepting professional diplomas in all member states, it is hoped that training periods performed by trainees according to this European Core Curriculum in an accredited training programmes in any member state should become accepted as equivalent to the same period of training in their own state.

The European Core Curriculum has to a large extent been harmonised with the Programme Requirements for Residency Education in Radiation Oncology issued by The American Board of Radiology. It is recommended that the appropriate bodies in the European Union and the United States of America engage in negotiations on reciprocity of accepting the residency training in radiotherapy (radiation oncology).

The European Core Curriculum in Radiotherapy (Radiation Oncology) should be regularly reviewed and updated.

3. CURRICULUM

3.1 Basic Sciences

Each trainee should during the training period acquire knowledge (level 1) or knowledge and skills (level 2) 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. An example 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).

Biology of cancer

Terminology and techniques of molecular biology (1)
 Hereditary cancer (1)
 Cancer genetics (1)
 Proliferation, cell cycle and cell death in cancer (1)
 Signal transduction (1)
 Genome maintenance mechanisms for preventing cancer (1)
 The microenvironment of the tumor-host interface (1)

Novel forms of treatment: immuno-, gene therapy, .. (1)**Radiobiology**

Interaction of radiation on molecular level (1)
 DNA damage (1)
 Cellular effects, mechanisms of cell death (1)
 Repair of radiation damage (1)
 Cell survival curves (1)
 Normal tissue systems (1)
 Solid tumor and leukemia systems (1)
 Effects of oxygen, sensitizers and protectors (1)
 Time-dose-fractionation, LET, radiation modalities (2)
 Acute and late normal tissue reactions (2)
 Tumor responses (2)
 Cytotoxic therapy and radiation (1)
 Predictive assays (1)

Basic radiation physics

Atomic and nuclear structure (1)
 Radioactive decay (2)
 Properties of particle and electromagnetic radiation (1)
 Radioisotopes (1)

Radiation physics applied in radiation therapy (RT)

X-ray tube (1)
 Linear accelerators (2)
 Specialized collimating systems (1)
 Cobalt units (1)
 Brachytherapy systems (1)
 Cyclotron (1)
 Microtron (1)
 Absorbed dose distributions (2)
 Target volume specification (2)
 Target absorbed dose specification in external RT (2)
 Target absorbed dose specification in brachytherapy (2)
 Algorithms for 2D dose calculations (1)
 3D planning, virtual and CT-simulation (2)
 Algorithms for 3D dose calculations (1)
 Principles, technical aspects and applications of conformal RT and IMRT (1)
 Special techniques (IORT, stereotactic RT) (1)

Radioprotection

General philosophy, ALARA (1)
 Stochastic and deterministic effects (1)
 Risk of induction of secondary tumours (1)
 Radiation weighting factor (1)
 Equivalent dose - tissue weighting factor (2)
 Dose limits for occupational and public exposure (2)
 European legislation (1)
 What is evidence based in radioprotection (1)

Imaging and target volume

Imaging modalities, procedures and technology (1)
 Disease oriented imaging (1)
 Image handling in radiotherapy (2)
 Target volume determination in clinical practice (2)
 GTV, CTV, PTV and relevant ICRU recommendations(2)
 Developments in imaging (1)

Clinical research and measurement of treatment outcome

Measurements of tumor control and toxicity (2)
 Study design (1)
 Types of trials (1)
 Interpretation and analysis (1)
 Life-table analysis (2)
 Tests of significance (1)
 Univariate/multivariate (1)

Specificity/sensitivity/validity/power (2)

Meta-analysis (1)
 Levels of evidence (2)
 Pitfalls: pilot studies, preliminary results, stage migration, fraud, .. (1)
 How to write, present, and interpret scientific data (2)

Basic Management and Economics of radiation therapy

e.g. calculation of costs, how to define work load, prediction for the need of radiotherapy, reimbursement systems (1)

3.2 Clinical Curriculum**Objectives**

Specialists in radiotherapy/ radiation oncology shall be able to 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, chose the radiation modality (or interdisciplinary modality), plan and apply optimal radiation therapy 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 diseases

Each trainee should during the training period acquire knowledge (level 1) or knowledge and skills (level 2) in the below listed topics:

Head & Neck

- Larynx (2)
- Oral cavity (2)
- Oropharynx (2)
- Hypopharynx (2)
- Nasopharynx (2)
- Salivary glands (2)
- Thyroid gland (1)
- Others (1)

Gastrointestinal (GI) Tract

- Oesophagus (2)
- Stomach (2)
- Small bowel (1)
- Colon/rectum (2)
- Anus (2)
- Biliary tract (1)
- Liver (1)
- Pancreas (1)

Lung/Mediastinum

- Non-small cell lungcancer (2)
- Small cell lungcancer (2)
- Thymomas and/or mediastinum tumours (2)
- Mesothelioma (1)

Bone & Soft Tissue (2)

Skin (2)

Breast (2)

Gynaecology

- Cervix (2)

- Endometrium (2)
- Ovaries and fallopian tubes (2)
- Vagina (2)
- Vulva (2)

Genitourinary (GU) Tract

- Prostate (2)
- Bladder (2)
- Testes/seminoma (2)
- Testes/nonseminoma (1)
- Kidneys (1)
- Ureter (1)
- Urethra (1)
- Penis (1)

Ophthalmic tumours (1)

Lymphomas & leukemias

- Hodgkin's disease (2)
- Non-Hodgkin's lymphoma (2)
- Leukemia (2)
- Multiple myeloma and/or plasmacytoma (2)
- Total body irradiation (1)
- Total skin irradiation (1)

Central Nervous System (2)

Unknown primary (2)

Palliation

- Skeletal metastases (2)
- Brain metastases (2)
- Cord compression (2)
- Vena caval syndrome (2)
- Obstruction disease (2)
- Bleeding syndromes (2)

Retreatment (1)

Paediatrics (1)

Benign disease (1)

4. References

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Table 1

The updated European Core Curriculum for radiotherapists has been endorsed on 14 December 2002 by the national societies and bodies of:

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|-----------------------|-------------|---------------------|---------------------|
| 1. Albania | 10. Estonia | 19. Letonia | 29. Sweden |
| 2. Austria | 11. Finland | 20. Lithuania | 30. Switzerland |
| 3. Belgium | 12. France | 21. Norway | 31. The Netherlands |
| 4. Bosnia Herzegovina | 13. Germany | 22. Poland | 32. Turkey |
| 5. Bulgaria | 14. Greece | 23. Portugal | 33. Ukraina |
| 6. Byelorussia | 15. Hungary | 24. Romania | 34. United Kingdom |
| 7. Croatia | 16. Ireland | 25. Russia | 35. Yugoslavia |
| 8. Czech Republic | 17. Israel | 26. Slovak Republic | |
| 9. Denmark | 18. Italy | 27. Slovenia | |
| | | 28. Spain | |