

# Overview of radiation oncology in the Czech Republic

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Received: 15.12.2008

Accepted: 22.12.2008

Subject: invited paper

## SUMMARY

**BACKGROUND:** Modern radiotherapy (RT) plays a very important role in both curative and palliative treatment of tumours. There are large variations among the EU countries and even regional variations within countries in the provision of RT.

**AIM:** In this report we present an overview of the current infrastructure, organisation, education and quality programme of radiotherapy in the Czech Republic.

**MATERIAL AND METHODS:** Data from the National Cancer Registry, Institute of Health Information and Statistics of the Czech Republic and from questionnaires and clinical audits of radiotherapy departments were used for evaluation of radiotherapy equipment, numbers of patients treated by radiotherapy and workload of radiotherapy facilities.

**RESULTS:** Radiotherapy of malignant diseases is provided in 28 facilities in the Czech Republic. There are 35 linear accelerators and 16 cobalt units for the population of 10.3 million inhabitants, which represents one megavoltage unit for 200 000 inhabitants. Fourteen departments are equipped for brachytherapy with high dose rate afterloading machines. Forty-three percent of newly reported cancer patients undergo radiotherapy as part of oncological treatment.

**CONCLUSION:** The main problem of radiation oncology in the Czech Republic is insufficient centralisation and the persistence of small, under-equipped departments.

**KEY WORDS:** radiation oncology, Czech Republic, infrastructure, national standards, main problems

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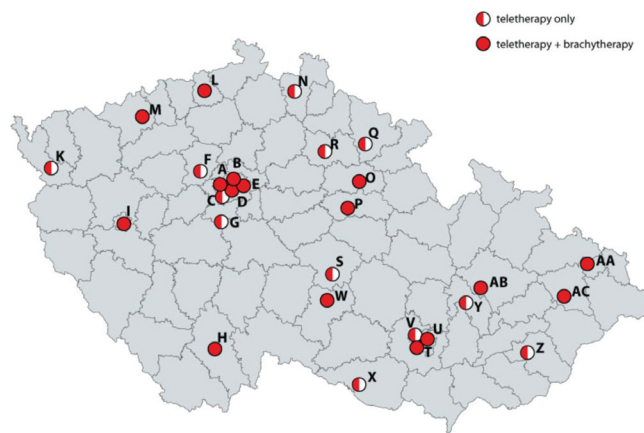
The Czech Republic has a population of 10.4 million inhabitants. The cancer incidence is very high. In 2005 the total number of cases of malignant neoplasms and carcinoma in situ (ICD-10 codes C00–C97 and D00–D09) newly reported to the National Cancer Registry was 71 449. The mortality was 28 033 cases. While the level of incidence of malignant neoplasms in the Czech Republic increases, mortality has exhibited an opposite trend since the second half of the 1990s (1).

The history of radiotherapy in Bohemia starts in the year of 1906 when the first radon spa in the world was founded in Jachymov (Joachimsthal). The uranium mines in Jachymov were a source of <sup>226</sup>Ra for brachytherapy until the nineteen sixties. The former Czechoslovakia in the second half of the 20<sup>th</sup> century

was also a producer of cobalt and caesium units and betatrons, which helped to establish a national network of radiotherapy departments. In the 1990s it became evident that this network was too dense and it was difficult to equip all radiotherapy facilities with modern technology. The Czech Society for Radiation Oncology, Biology and Physics (SROBF) prepared in the year 1995 technical and staff requirements and a quality assurance/control programme for radiotherapy departments and started to support centralization of curative radiotherapy to well equipped centres. This process is very slow, because until recently there was insufficient support from the Ministry of Health and of health insurance companies. The large state and university hospitals had only a limited budget for development of

radiotherapy, while small hospitals were very interested to keep radiotherapy departments and not to be forced to send their patients away. In the years 2004–2006 the SROBF prepared national standards of radiation oncology and proposal of clinical audit of radiotherapy departments. This project was supported by the Ministry of Health. The standards define minimal infrastructure of radiotherapy departments and requirements for the quality of the process of radiotherapy. The standards are published on the website of the SROBF ([www.srobf.cz](http://www.srobf.cz)) and were accepted by the Ministry of Health and health insurance companies; they are very helpful in negotiations about reimbursement and the future of radiation oncology in the Czech Republic. The National Cancer Register has collected data about incidence and mortality of cancer in the Czech Republic since the 1950s and is a useful source of information about numbers of patients treated by radiotherapy and about the required capacity of radiotherapy.

At present, radiotherapy of malignant diseases is provided in 28 facilities (Fig. 1), but only half of them have at least two linear accelerators. Both external beam radiotherapy



**Fig. 1.** Network of Czech radiotherapy facilities in 2007/2008 (A) UH Kralovske Vinohrady /Prague/, (B) General UH /Prague/, (C) Thomayer UH /Prague/, (D) UH in Motol /Prague/, (E) UH na Buloyce /Prague/, (F) Kladno, (Ci) Institute of Oncology and Rehabilitation Ples, (H) Ceske Budejovice, (I) UH Pilsen, (K) Cheb, (L) Usti nad Labem, (M) Chomutov, (N) Liberec, (O) UH Hradec Kralove, (P) Pardubice, (Q) Trutnov; (R) Jicin, (S) Havlickuv Brod, (T) Masaryk memorial Cancer Institute /Brno/, (U) UH Brno, (V) St. Anne’s UH Brno, (W) Jihlava, (X) Znojmo, (Y) Prostějov, (Z) Holesov (AA) UH Ostrava, (AB) Uf I Olomouc, (AC) Novy Jicin. (Noto: UH = University Hospital)

**Table 1.** Numbers of RT machines in the Czech Republic over the period 1999–2008

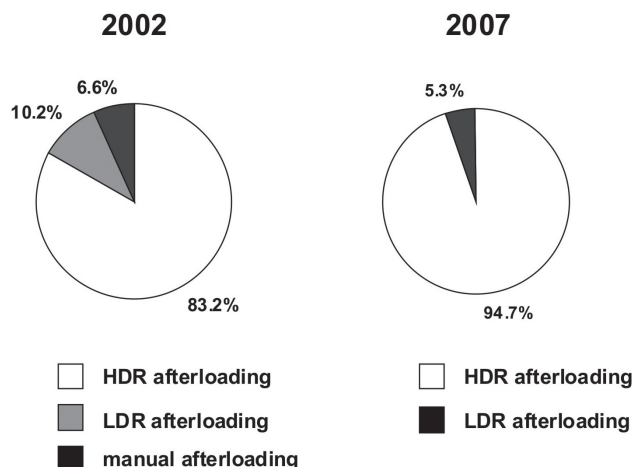
RT machine	1999	2001	2003	2004	2008
Linear accelerator	17	18	24	28	35
60Co unit	30	28	25	21	16
Betatron	3	2	0	0	0
X-ray therapy	34	28	24	24	25
Afterloading brachytherapy	15	16	18	21	17
Simulator	17	18	19	22	28
Treatment planning system (TPS)	36	37	50	55	

**Table 2.** Radiotherapy equipment in the Czech Republic compared to the European data

Parameter <sup>1</sup>	European average 2003 <sup>(2)</sup>	Czech Republic 2003	Czech Republic 2008
Number of MV per 10 <sup>6</sup> of inhabitants	5.9	4.8	5
1MV/n	170 000	208 000	202 000
LA/Co	3.26	0.96	2.2
1LA/n	222 222	416 000	294 000

<sup>1</sup> MV = megavoltage unit; n = number of inhabitants; LU = linear accelerator; Co = cobalt unit

<sup>2</sup> Source: Bentzen, Radiotherapy and Oncology, 75(2005), 355 – 365



**Fig. 2.** Growing accessibility of HDR afterloading devices in the Czech Republic (years 2002 and 2007)

and brachytherapy are performed in 16 departments. Twelve departments are at university hospitals, 4 in regional hospitals, 3 are private and 9 are in local hospitals. An additional 10 facilities are equipped with orthovoltage X-ray units and serve for radiotherapy of non-malignant diseases, mostly painful degenerative disorders.

The equipment with modern technique is not satisfactory but is relatively fast improving (Table 1). At present, there is one linear accelerator per approximately 300 000 inhabitants and one megavoltage unit (linear accelerators + cobalts) per 200 000 inhabitants. Table 2 provides a comparison with the European data. Twelve centres are able to perform intensity-modulated radiotherapy and 10 cen-

tres use image-guided radiotherapy. Stereotactic radiotherapy is provided by 2 university hospitals (University Hospital Motol, Prague and Masaryk Memorial Cancer Centre, Brno). The radiosurgery department of the Hospital Na Homolce, Prague, is equipped with a gamma knife.

All 16 radiotherapy departments that provide brachytherapy are equipped with automatic afterloading devices; from 18 afterloaders 14 are high dose rate and 4 low dose rate (Fig. 2).

The number of patients treated by radiotherapy is monitored by the Institute of Health Information and Statistics of the Czech Republic. On average 43% of newly reported cancer patients undergo radiotherapy as part of oncological treatment (Table 3). Numbers of new patients treated by radiotherapy and numbers of radiation oncologists in 28 radiation oncology facilities across the Czech Republic are presented in Figure 3.

In 2005 the SROBF with the support of the Ministry of Health carried out a survey focused on the structure, equipment, staff, treatment quality and workload of radiotherapy facilities in the Czech Republic. This survey was part of preparation of on-site clinical audits. A questionnaire was sent to all 28 radiotherapy facilities. Selected data are presented in Table 4 and Figures 4, 5.

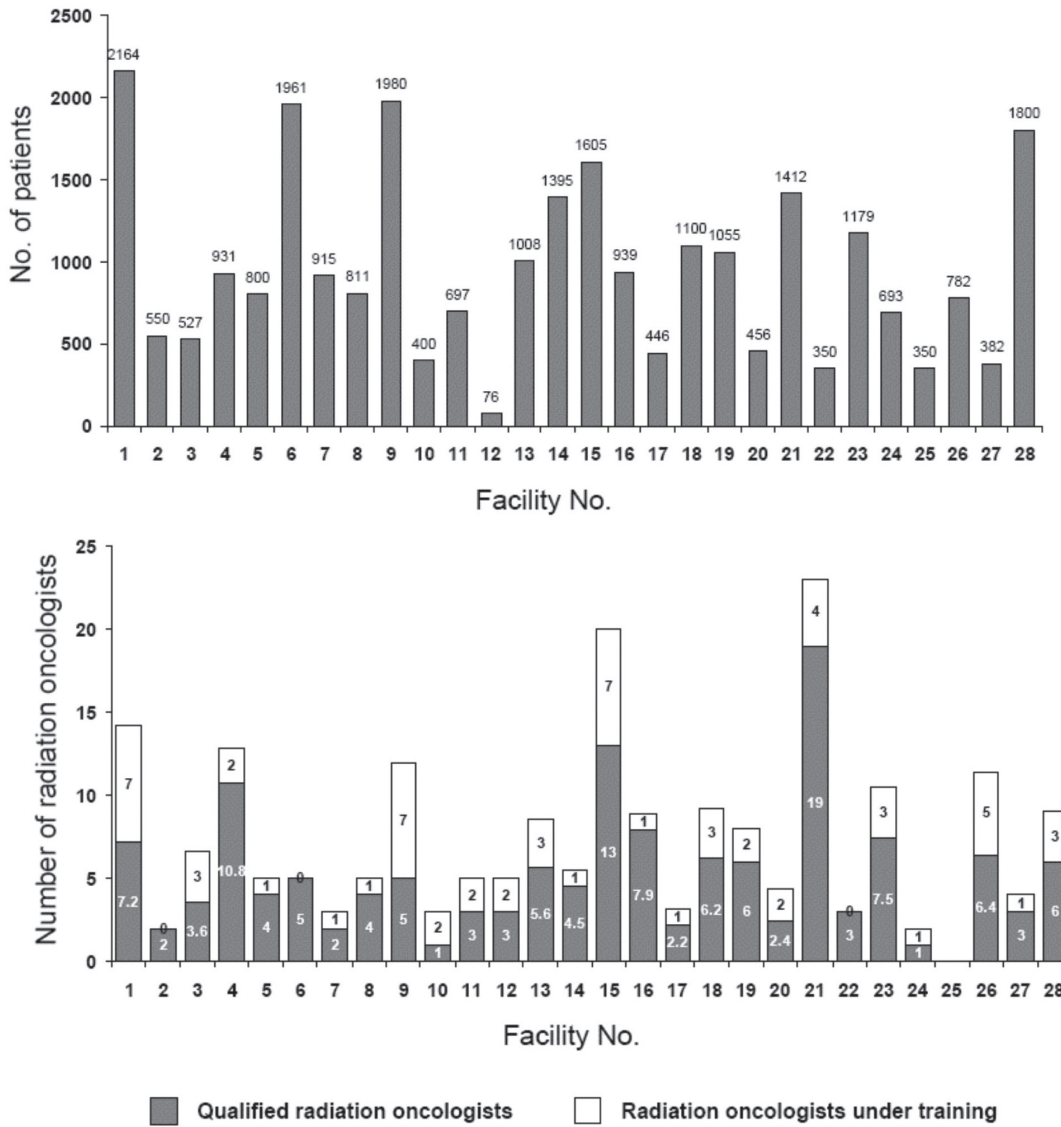
Between 2004 and 2006 the SROBF performed clinical audits at radiotherapy departments of 8 university hospitals. The project was supported by the Ministry of Health (in agreement with EC Directive 97/43). The aim

**Table 3.** Newly reported cancer patients and the number of patients treated with radiotherapy in 2004

Main cancer diagnoses	No. of newly reported cancer patients <sup>1</sup>	No. of patientstreated with RT <sup>2</sup>	RT-treated patients (% of all reported cases)
Lung	6 242	2 389	38.3 %
Breast (females)	5 628	4 600	82.0 %
Prostate	4 289	1 674	39.0 %
Rectum	2 211	1 831	82.8 %
Corpus uteri	1 734	1 016	58.6 %
Cervix uteri	1 033	813	78.7 %
All cancer locations without skin cancer	53 522	23 079	43.0 %

<sup>1</sup> Czech National Cancer Registry

<sup>2</sup> Survey performed by the Czech Society for Radiation Oncology, Biology and Physics (SROBF).



**Fig. 3.** Number of newly diagnosed patients treated with RT and the number of radiation oncologists in 28 Czech radiation oncology facilities (2007)

of the audits was to evaluate whether the technical equipment, staff, numbers of patients, quality of oncological care and radiotherapy procedures, local treatment protocols and physical aspects of radiotherapy are in accordance with national standards of radiation oncology. In most centres the audits helped the heads of radiotherapy departments in their negotiations with hospital management and their effort to improve the quality of radiation oncology. Unfortunately, the project of clinical

audits was discontinued by the Ministry of Health in 2007.

A more recent overview of radiotherapy in the Czech Republic was obtained in 2007 when the European Society for Therapeutic Radiology and Oncology (ESTRO) organized a survey called Patterns of Care of Brachytherapy. The results are summarized in Tables 5 and 6.

The State Office for Nuclear Safety (SUJB) publishes quality assurance recommendations for radiation oncology and performs regular

**Table 4.** The number of patients treated with radiotherapy and the number of irradiated fields (2004)

Facility No.	All patients treated with RT	New patients treated with RT	New patients-teletherapy	New patients – brachytherapy	No. of LA	No. of <sup>60</sup> Co units	Fields per 1 LA	Fields per <sup>60</sup> Co unit	Waiting time for RT (days)
1	1820	1672	1653	181	2	0	40492	0	16
2	368	220	180	165	0	1	0	5909	3–7
3	2759	891	891	0	1	1	24208	19974	15
4	2123	878	870	115	2	0	45201	0	15
5	1508	1060	813	341	2	1	26459	8389	10
6	2897	1077	1021	88	1	1	47683	28794	2
7	1023	813	801	158	2	1	43050	15514	45
8	1456	1262	1210	174	3	0	29916	0	21
9	830	620	620	39	0	1	0	34482	7–10
10	1226	882	861	134	3	0	25393	0	5
11	254	200	200	0	0	1	0	NR	7
12	1106	936	906	126	1	1	86211	17119	26
13	2511	823	823	59	2	0	28587	0	10
14	465	437	437	0	1	1	30500	100	10
15	1659	728	554	174	2	1	45926	1734	21
16	211	190	190	0	0	1	0	18100	7-10
17	563	532	532	0	0	1	0	44503	4
18	279	249	249	0	0	1	0	24127	10
19	796	507	487	62	1	0	39567	1595	14
20	154	149	149	0	0	1	0	6609	1
21	1013	980	980	19	1	1	49730	17197	5–21
22	950	825	825	26	1	1	63900	368	7
23	524	420	420	0	0	1	0	11736	5
24	83	83	83	0	0	1	0	5139	4
25	404	362	321	0	0	1	0	20756	5
26	1118	509	484	33	1	1	32190	7210	14
27	389	348	321	0	0	1	0	12183	4
28	1215	1215	1215	97	2	0	52500	0	2-3
Total	29704	18868	18096	1991	28	21			

LA = linear accelerator, RT = radiotherapy, NR = not reported

audits of radiotherapy departments. Audits have the following tasks:

- to perform an independent quality check of the radiotherapy equipment
- to unify the dose evaluation in all radiotherapy departments in the Czech Republic
- to improve clinical practice and professional supervision.

Both on-site audits (maximally 5-year period) and correspondence dosimetric audits are used. In addition some radiotherapy departments also participate in international audits organised by ESTRO or IAEA.

Training of medical specialists in radiation oncology and of medical physicists in the field of radiation oncology is conducted in ac-

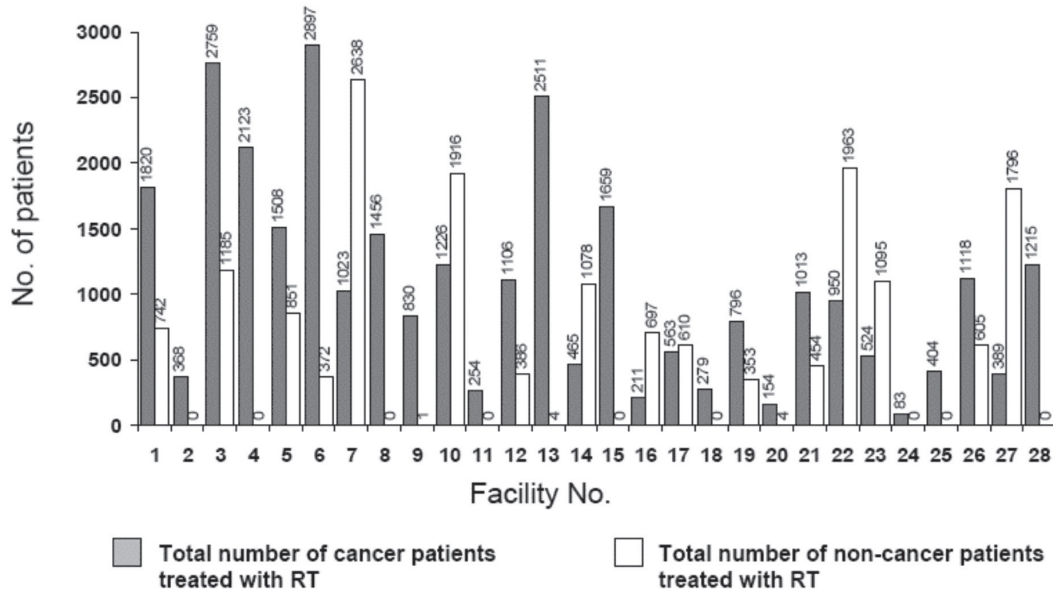


Fig. 4. Number of Cancer patients and non-cancer patients treated with RT (2004)

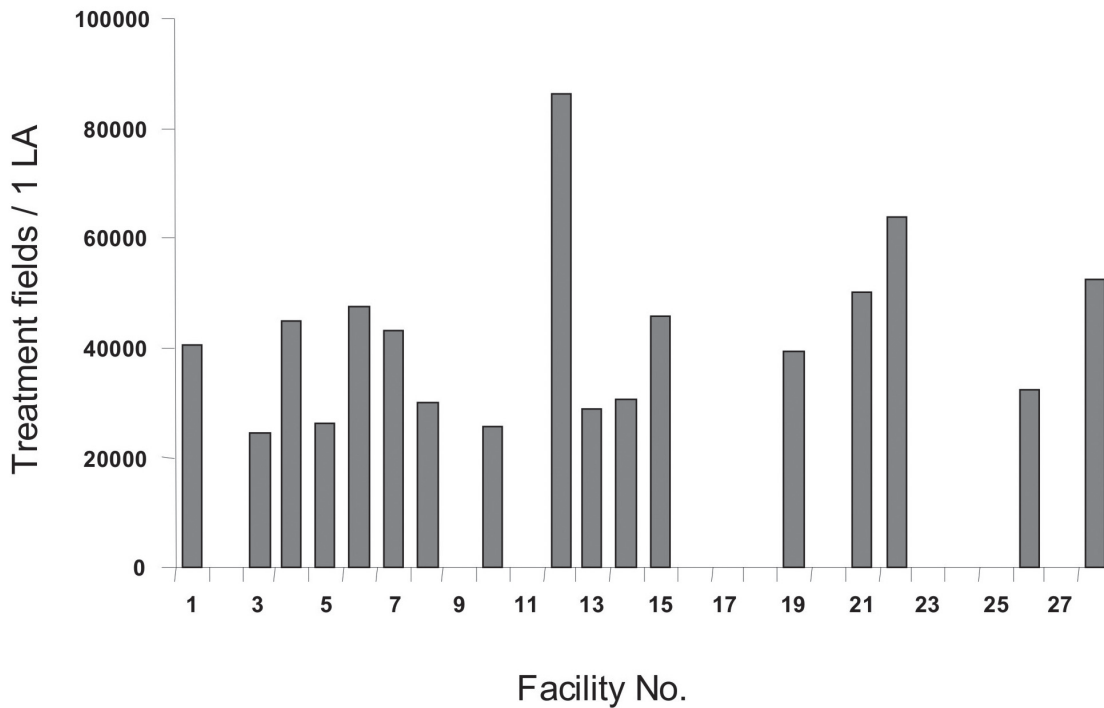


Fig. 5. Average number of treatment fields per 1 linear accelerator (LA) in Czech RT facilities (2004)

credited teaching centres. The six-year study programme meets the requirements of the Recommended Curriculum for the Specialist

Training of Medical Practitioners in Radiotherapy (Radiation Oncology) within Europe and allows radiation oncologists to prescribe

**Table 5.** Summary indicators of Czech radiotherapy (data from survey performed in 2007)

Indicator	Value
No. of radiotherapy (RT) facilities	28
No. of new patients treated with RT	26 764
No. of qualified radiation oncologists	148
No. of radiation oncologists under training	65
No. of RT facilities with brachytherapy	16
No. of patients treated with brachytherapy	1847
No. of performed brachytherapy applications	7272

**Table 6.** The number of newly diagnosed patients treated with brachytherapy (data from ESTRO survey, 2007)

Cancer location	No. of patients (%)
Endometrium	832 (45.0 %)
Cervix	407 (22.0 %)
Breast	285 (15.5 %)
Skin	137 (7.5 %)
Bronchus	88 (4.8 %)
Prostate	23 (1.2 %)
Vagina	15 (0.8 %)
Other	14 (0.7 %)
Anus	13 (0.7 %)
Head and neck	12 (0.6 %)
Soft tissue sarcomas	8 (0.4 %)
Oesophagus	7 (0.4 %)
Vulva	6 (0.3 %)
Total	1847 (100 %)

also chemotherapy, hormonal therapy and biological therapy. Accreditation is granted by the accreditation committee of the Czech Ministry of Health.

Future perspectives of radiation oncology in the Czech Republic include:

- improvement of reimbursement of radiotherapy;
- concentration of modern technology and specialists in large university centres;
- implementation of standards in radiation oncology and of clinical audits;

- improvement of multicentre and international cooperation;
- support of research and publication activities†
- cooperation with other European countries [3].

The Czech Society of Radiation Oncology, Biology and Physics in cooperation with the National Cancer Registry and Institute of Biostatistics and Analyses, Masaryk University, Brno, is now performing a study focused on the impact of access to radiotherapy on the results of oncological treatment in the Czech Republic.

**Acknowledgements:**

The study was supported by Research Project MZO 00179906 of the Ministry of Health, Czech Republic and by the project Czech National Cancer Programme On-line supported by Astra Zeneca

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