Rep Pract Oncol Radiother, 2005; 10(4): 209-216

Review Paper

Received: 2004.02.11
Accepted: 2004.03.21
Published: 2005.09.20

The state of Hungarian radiotherapy

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Summary

Background Hungary suffers from one of the highest levels of cancer morbidity, with over 700 new cases per 100000 inhabitants per year. This situation necessitates, among others, investigation of the current state of radiotherapeutic care, and its infrastructural and staffing conditions.

Aim The aim of this paper is to present the current state of Hungarian radiotherapy.

Results Although the number of radiation treatments increased substantially between 1995 and 2003 (16544 vs. 26316), together with a considerable increase in the linear accelerator equivalent (LAE) value (15.9 vs 29.45), about one-third of the patients who would profit from radiotherapy do not receive this form of treatment. Radiotherapeutic care is provided at 13 centers in 7 geographical regions, with widely varying infrastructural and staffing conditions, characterized by a mean LAE value of 4.2 (range: 0–8.45), a 1 LAE value for a mean of 343500 inhabitants (range: 0–731500), and a mean annual workload of 353 patients per radiation oncologist (range: 255–424), 532 patients per physicist (range: 255–911) and 149 per radiation technologist (range: 71–300). These conditions result in a waiting list of between 0 and 42 days for non-emergency cases and a mean of 260 radiotherapy-treated patients per 100000 inhabitants (range: 111–434) in the different geographical regions, which is far below the expected Hungarian value of 403 radiotherapy-treated cases/year.

Conclusions Attainment of an adequate radiotherapeutic service with an acceptable waiting time throughout Hungary requires the creation of 2 additional centers and the reconstruction of 1 existing center, the provision of 9 new linacs, the replacement of 10 functioning telecobalt units with linacs, and increases of 54% in the number of radiation oncologists, 51% in the number of physicists and 65% in the number of radiation technologists.

Key words **Hungary • radiotherapy infrastructure • radiotherapy resources**

Full-text PDF: http:/www.rpor.pl/pdf.php?MAN=7838

Word count: 2195
Tables: 10
Figures: 1
References: 24

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Background

The infrastructure of Hungarian radiotherapy has been improved considerably in the past decade. However, this development has not eliminated the existing deficiencies and there still remain significant interregional differences. In the 7 geographical regions of the country, with overall 10 million inhabitants, there are currently 13 radiotherapeutic departments (Figure 1); the workload, infrastructural and staffing conditions of these will be discussed separately. The data published here were gathered from the heads of the individual departments and from the indices provided for the ESTRO QUART reports [1].

Results

Thirty per cent of Hungarian patients who would profit from radiotherapy are not treated

The annual number of patients requiring irradiation can be calculated from the morbidity data to be found in the National Cancer Registry [2]. Tables 1 and 2 show the total number of new cancer cases and their distribution according to the location of the disease in the past 5 years. Hungary suffers from one of the highest levels of cancer morbidity, with over 700 new cases per 100000 inhabitants per year. Consultations with epidemiologists and mathematicians suggest that there may be some uncertainties (overestimation) in the reported data; thus the nationwide radiotherapy need was calculated for an estimated 70000 new cancer cases per year. In the future, however, it is essential that the quality of the National Cancer Registry data improve, as any planning should be based on valid and accurate epidemiological facts.

The number of patients needing radiotherapy can be calculated from the total number of new cancer patients per year. Around 50% of all new cancer patients require irradiation at some stage of their disease. As at least 15% of these cases need one or more subsequent series of radiotherapy during their clinical course, this must also be taken into acount to determine the annual radiotherapy capacity requirements [3–5]. The number of patients treated with radiotherapy (Table 3) has increased significantly in the past decade, from 16544 in 1995 [4] to 26316 in 2003 (present report). This means that even in 2003 about one-third of the patients who would have benefited from radiotherapy were not irradiated (the projected value for 2004 is 30%). This proportion of patients who required radiotherapy, but who were not irradiated in 2003 reasonably reflects the deficiencies of the national radiotherapy infrastructure.

Figure 1. Regions and cities with radiotherapeutic departments. Cities denoted in italics with white points are sites of planned new centers or a center needing reconstruction.

Table 1. Total number of new cancer patients [2].

Year	No. of patients
1999	70438
2000	84049
2001	76321
2002	76027
2003	75801

The National Cancer Registry [2] data and the conventional radiotherapeutic demand indicate that the number of cases requiring radiotherapy is 403 per 100000 inhabitants per year. This level (Table 4) is attained only in the region served by the capital (434 cases). However, it must be mentioned that a significant proportion of these patients come from other geographical areas. Among the regions, Western Transdanubia with its 358 irradiated cases per year almost reaches the statistically expected level. The other regions do not treat an adequate number of patients, or a certain proportion of the patients are irradiated in the region served by the capital. The situation is worst in Central Transdanubia (Figure 1), with 1.1 million inhabitants, but with no radiation department at all.

Thus, about 30% of the cancer patients who would benefit from radiation therapy are not

Table 2. Number of new cancer patients and their distribution in terms of the disease location [2].

Location of disease	1999	2000	2001	2002	2003
Thorax	8366	12699	12214	11658	11132
Breast	9795	9421	7448	8551	8400
Gastrointestinal	13580	18297	17454	17008	16148
Genitourinary	8980	9352	8155	8611	10010
Head and neck	6752	6962	6215	5901	5728
CNS	1450	2272	2200	2209	2197
Hematological	3316	3882	3558	3120	3250
Skin and melanoma	10585	12029	11108	11479	11409
Gynecological	4938	5239	4571	4229	4131
Orthopedic	1306	1654	1441	1509	1508
Other	1370	2242	1957	1752	1888
Total	**70438**	**84049**	**76321**	**76027**	**75801**

Table 3. Regional distribution of irradiated patients.

	1995	2003
Estimated total no. of cancer patients	45000*	70000**
No. of patients requiring radiotherapy	25875	40250
No. of patients irradiated		
Central Hungary	7616	12296
Western Transdanubia	1639	3596
Southern Transdanubia	1134	2395
Southern Great Plain	1328	3315
Northern Great Plain	3169	3287
Northern Hungary	1658	1427
Central Transdanubia	0	0
Total	**16544**	**26316**
Deficiency*** (%)	9331 (36)	13934 (35)

* Based on [4];
** Based on [2];
*** Number of patients requiring, but not receiving radiotherapy.

Table 4. Numbers of irradiated patients per 100000 inhabitants in the various regions in 2003.

Regions	No. of irradiated patients	No. of irradiated pts per 100000 inhabitants
Central Hungary	12296	434
Western Transdanubia	3596	358
Southern Great Plain	3315	244
Southern Transdanubia	2395	244
Northern Great Plain	3287	213
Northern Hungary	1427	111
Central Transdanubia	0	0
Total/mean	**26316**	**260**

treated, this proportion exhibiting a very uneven regional distributions. The situation emphasizes the clear need for an improvement of the national infrastructure. Moreover, the graduate and postgraduate education in oncology is not fully adequate either, and colleagues in other specialities are often not sufficiently familiar with the indications for radiotherapy, which leads to a loss of patient referral.

Unequal access to the radiotherapy infrastructure

Not all patients can receive radiation therapy near their homes: this is true in some cases for the total number of patients in a region, but additionally the geographical distribution of the centers is inadequate. Further, easily accessible public transportation to these departments remains an unresolved problem.

The capacity of the radiotherapy equipment can be best characterized by the linear accelerator

Table 5. Linear accelelator equivalent values in different regions.

Regions	LAE indices for the Hungarian regions		
	1995 [4]	Present report	Rate of increase
Southern Transdanubia	0.75	3.75	5
Southern Great Plain	1.75	6.5	3.7
Northern Great Plain	2.5	5.5	2.2
Northern Hungary	0.95	1.75	1.8
Western Transdanubia	2.25	3.5	1.6
Central Hungary	7.7	8.45	1.1
Central Transdanubia	0	0	–
Total/mean	15.9	29.45	1.9
Participation of the capital (%)	48	29	

Table 6. Regional infrastructure of radiotherapy.

Regions	LAE value	No. of inhabitants per one LAE value	No. of centers
Southern Great Plain	6.5	209500	3
Southern Transdanubia	3.75	262000	2
Northern Great Plain	5.5	281000	2
Western Transdanubia	3.5	287000	2
Central Hungary	8.45	335000	3
Northern Hungary	1.75	731500	1
Central Transdanubia	0	0	0
Total	**29.45**	**343500**	**13**

equivalent (LAE) index (linear accelerator: 1, cobalt machine: 0.75, betatron: 0.5 and cesium machine: 0.2) [3,6]. The LAE index for Hungary overall has recently improved significantly, from 15.9 in 1995 [4] to 29.45 in the present report. It is a very positive change that the provincial centers have developed much more rapidly than those in the capital: the participation of the provinces in the infrastructural development has increased from 52% to 71% (Table 5). The currently existing 13 centers can be divided into 3 groups on the basis of infrastructure: the National Institute of Oncology and the Municipal Oncoradiological Center at Uzsoki Hospital in Budapest, and the Universities of Debrecen, Kaposvár and Szeged are on an acceptable European level. Seven other departments approach this level, whereas the condition at the Department of Radiology and Oncotherapy at Semmelweis University (Budapest) are significantly below these requirements. The current situation as compared with that 9 years ago reveals marked progress: of the 11 centers functioning in 1995, only 1 could then supply radiotherapy at an European level.

The current international standards [1] stipulate that the required LAE index for 10 million inhabitants in well-developed countries is 50; this means that there is a 40% deficiency in the national radiotherapeutic instrumentation in Hungary. Hungarian radiotherapy faces the additional unresolved problem of the urgent replacement of the 10 telecobalt machines purchased in the late 1990s.

ESTRO QUART recommends one linear accelelator per 200000 inhabitants in well-developed countries, but in Hungary this level is met (Table 6) only in the Southern Great Plain

Table 7. Hungarian and international recommendations for the number of specialists as a function of the yearly workload.

Staff members	Hungarian recommendations [10]	International recommendations*	
		Horiot et al. [11]	ICRP [12]
Radiotherapists	1/200–250 pts	1/250 pts	1/200–250 pts
Physicists	1/400 pts	1/600 pts	1/400 pts
Technologists	1/150 pts	1/60 pts	2–3/linac/shift
	1/simulator		1–2/simulator/shift
	1/brachytherapy		1/brachytherapy

(1 linac/209000 inhabitants). The situation is close to acceptable in Southern Transdanubia (1 linac/262000 inhabitants), while the worst-equipped regions are Central and Northern Hungary and Central Transdanubia.

The average number of megavoltage units per radiotherapeutic department in Europe is 2.6 [7]. If the goal for the development of Hungarian radiotherapy for 2010 is to reach the infrastructural level recommended in developed countries for 1994 (40 linacs per 10 million people; UNSCEAR [8]), 15 centers (40/2.6=15) are needed in Hungary instead of the currently functioning 13. To determine the best locations for the establishment of 2 new centers, the number of inhabitants, the length of the waiting time (see later) and the geographical distribution of the existing departments must be taken into account. These factors suggest that the best locations for the new centers would be Northern Hungary and Central Transdanubia, in accord with the consensus statement of the Hungarian College for Radiotherapy and Oncology in December 13, 2001 [9]. At the same time, reconstruction of the Budapest center at Semmelweis University (with only a single cesium unit and one set of after-loading equipment) seems necessary. Semmelweis University is the only Hungarian medical university without a modern radiotherapeutic infrastructure. In the absence of such instrumentation, the university cannot expect to meet the standards required by graduate and postgraduate training, and continuous medical education.

Unequal access to high-quality radiotherapy

The outcome of cancer depends decisively on the staffing conditions and on the length of the waiting list; thus, numerical values of these factors must likewise be determinants in the planning of the location of radiotherapy units.

Unequal staffing conditions

The quality of the radiotherapy provided depends to a major extent on the availability of an adequate number of skilled personnel. Table 7 presents the Hungarian and international recommendations concerning the permitted workload for medical staff (radiotherapists, medical physicists and technologists). The background of these recommendations is that a workload exceeding the suggested threshold has an appreciable negative impact on the quality of the radiotherapy.

If we consider the number of patients irradiated in 2003 (26316), 105 physicians, 66 physicists and 175 technologists would be needed on the basis of the national recommendations. However, only 74.5 radiation oncologists (the mean number is 5 per center, range: 2–13; some of the employed personnel work as part-time employees), 49.5 physicists and 177 technologists were engaged in this work (Table 8). Thus, in 2003 there was a considerable shortage of radiotherapists (29%) and radiation physicists (25%). The number of technologists met the Hungarian recommendations, but it must be mentioned that these recommendations prescribe a 2.5 times greater workload for technologists as compared with the international recommendations. The present situation must therefore be changed in the near future in order to harmonize the workload with the international standards (60 patients per year). To summarize, the current workload of physicians, physicists and technologists in Hungary is considerably above the international recommendations.

In the past 7 years, 14 specialists have left their profession (possibly permanently). It is worthy of note that half of them did so in Central Hungary. If the loss involving women specialists on maternity leave is included, the figure reaches 21.

Table 8. Number of specialists in 2003.

Regions	Radiotherapists employed in radiotherapeutic centers*	Qualified radiotherapists not engaged in radiotherapy**	Physicists	Technologists in external radiotherapy
Southern Great Plain	13	1	13	29
Southern Transdanubia	8.5	1	6	25
Northern Hungary	5	0	3	20
Western Transdanubia	11	1	7	27
Northern Great Plain	8	4	7	35
Central Hungary	29	14	13.5	41
Central Transdanubia	0	0	0	0
Total	**74.5**	**21**	**49.5**	**177**

* Including the number of part-time practitioners dealing with medical oncology;
** Including colleagues on maternity leave.

Table 9. Workload of staff members in 2003*.

Regions	Radiotherapists*	Physicists	Technologists
Southern Great Plain	255	255	114
Southern Transdanubia	282	399	96
Northern Hungary	285	476	71
Western Transdanubia	327	514	133
Northern Great Plain	411	470	94
Central Hungary	424	911	300
Central Transdanubia	0	0	0
Mean	353	532	149

* Including radiotherapists with a medical oncology speciality.

In 2003, the average number of cancer patients treated yearly per radiotherapist (Table 9) was 353 (range in the different geographical regions: 255–424 pts). The workload varied markedly among the regions and centers (the latter data are not shown), but it exceeded the acceptable limit (250 pts per year) in almost all the regions, and was especially high in the Budapest area (424 pts) and the Northern Great Plain (411 pts). This workload can be reduced by applying residents (according to Flynn and Hussey, the work of one resident is equivalent to 0.35 of that of a specialist [13]). The real situation is much worse, since the displayed data are not corrected for the working time spent by the employed radiotherapists in teaching activities and administrative responsibilities. An additional distorting factor is that the activity of a noteworthy proportion of the radiotherapists also includes the solving of tasks of medical oncologists. A further problem is that practitioners who have qualified in both radiotherapy and medical oncology sometimes devote comparatively little attention to radiotherapy. Although the influence of the above factors can be estimated only approximately, the data in Table 9 can be regarded as reflecting a workload underestimated by 30–40%. The average workloads of radiation physicists and technologists are 532 and 149 patients per year, respectively. The figures relating to Central Hungary and Western Transdanubia are especially high (Table 9).

Table 10. Desirable aims to be met by 2010.

	Planned value	Deficiency	
		No.	%
No. of irradiated patients	40250	13934	35
Max. waiting time (days)	10	32	>100
LAE index	40	11	28
No. of radiotherapy centers	15	2	13
Staffing numbers			
Specialists	161	86.5	54
Physicists	101	51.5	51
Technologists	537	347	65

The effects of a work overload are manifested in a reduced amount of time spent with the individual patients and a lower quality of the radiotherapy provided. Finally, the important role played by each radiotherapeutic center in the education of the residents must be taken into considerations: a work overload clearly affects the level of education of the young specialists (and that of self-education), the consequences of which are long-lasting and self-destructive.

Long waiting list

According to Mackillop et al, a delay in the onset of radiotherapy in the case of epithelial cancers decreases the rate of a positive outcome by 10% per month [14]. The waiting time inversely affects the quality of the radiotherapy. In the national centers, the average waiting time for non-emergency in- and outpatients is 2 weeks (range: 0–6 weeks). The longest waiting times are in Central Hungary, possibly due to the lack of sufficient radiotherapeutic departments in Budapest and its neighborhood (Central Transdanubia and Northern Hungary). The data indicate a shortage of radiotherapeutic beds in a number of centers (not shown). In such cases, an increase of the bed number seems absolutely necessary if the quality of the patient care is to be improved.

Conclusions and aims

Fundamental deficiencies and negative factors

Neither the quality nor the quantity of the radiotherapeutic infrastructure is satisfactory, and the regional differences are substantial in both respects. The workload of the staff is too high, again with considerable regional differences.

Desirable aims to be met by 2010 (Table 10)

– A 25% development of the existing national infrastructure in order to attain the minimum international recommendation (UNSCEAR: 40 linacs for 10 million inhabitants) [8];
– An increase of the number of high-quality radiotherapeutic instruments;
– An increase of the numbers of the staff in all specializations by a factor of 2 or more;
– A reduction of the waiting time for non-emergency cases to 10 days or less.

Most reasonable strategic developments

– The creation of 2 new radiotherapy departments (preferably in Northern Hungary and Central Transdanubia) and reconstruction of the department at Semmelweis University in Budapest;
– Increases of the number of beds in departments with long waiting lists for inpatients;
– Expansion of the radiotherapy infrastructure;
• The installation of 9 new linacs;
• The replacement of 10 existing telecobalt units with modern linacs;
• The replacement of linacs, brachytherapeutic equipment and simulators older than 10 years;
– Improvement of the quality of radiotherapy;
• Increase of the number of staff;
• Increase of the level of education of the entire staff;
• The purchase of devices for special irradiation techniques.

Financial background needed for improvements

– Purchase of equipment would be feasible if amortization were taken into account in the National Health Insurance Fund reimbursement policy;
– The creation of new departments would demand the provision of financial support (private or state).

Achievement of the suggested aims would be of major help in harmonizing the level of Hungarian radiotherapy with that in more developed countries, in order to ensure the best available care for all patients requiring radiotherapy [15–24].

REFERENCES:

1. ESTRO Quarts Project Quantification of Radiation Therapy Infrastructure and Staffing Needs (Qlg4-CT-2002-30583). *www.estro.be*
2. National Cancer Registry. National Institute of Oncology, Budapest, Hungary
3. Lote K, Möller T, Nordman E et al: Resources and productivity in radiation oncology in Denmark, Finland, Iceland, Norway and Sweden during 1987. Acta Oncol, 1991; 30: 555–61
4. Ésik O, Rényi J, Németh G: [State of radiotherapy in Hungary in 1996 and principles of development] In Hungarian. Orvosi Hetilap, 1996; 137: 2907–15
5. Ésik O, Seitz W, Lövey J et al: External audit on medical decision-making at the departments of radiotherapy in Budapest and Vienna. Radiother Oncol, 1999; 51: 87–94
6. EROPAQ project. Sponsored by the Ministry of the Flemish Community (1993–1995) Project leader: van der Schueren E
7. Bernier J, Horiot J-C, Bartelink H et al: Profile of radiotherapy departments contributing to the Cooperative Group of Radiotherapy of the European Organization for Research and Treatment of Cancer. Int J Radiat Oncol Biol Phys, 1996; 34: 953–60
8. UNSCEAR (United Nations Scientific Committee on the Effects of Atomic Radiation). Report. New York, Annex, 1994; 58
9. Minutes of the Hungarian College for Radiotherapy and Oncology (13 December, 2001)
10. [Minimum requirements in radiotherapy] In Hungarian. Departmental order signed by the Minister of Health. 16/2004 (III.23)
11. Horiot JC, Bernier J, Johansson K-A et al: Minimum requirements for quality assurance in radiotherapy. Radiother Oncol, 1993; 29: 103–4
12. ICRP (International Recommendation on Radiation Protection) No 44. Protection of the patients in radiation therapy. Pergamon Press, Oxford-New York-Frankfurt, 1985
13. Flynn DF, Hussey DH: Review of the manpower issue in radiation oncology. Int J Radiat Oncol Biol Phys, 1992; 24: 909–12
14. Mackillop WJ, Bates JHT, O'Sullivan B, Whiters HR: The effect of delay in treatment on local control by radiotherapy. Int J Radiat Oncol Biol Phys, 1996; 34: 243–50
15. Ebel E: Organization and clinical experience of the pain clinic at the Greatpoland Maria Skłodowska-Curie Cancer Centr in Poznań. Rep Pract Oncol Radiother, 1999; 4: 45–6
16. Heeren G: Towards a new legal framework for radiotherapy in the EU member states: Is there a scope for harmonisation? Can ESTRO contribute? Rep Pract Oncol Radiother, 1999; 4: 91–2
17. Heeren G: Education, science and quality assurance in radiotherapy in Europe. Rep Pract Oncol Radiother, 2002; 7: 7–9
18. Janiszewska M, Nowakowski G: Dosimetric verification of dynamic wedged fields. Rep Pract Oncol Radiother, 2003; 8: 139–52
19. Malicki J, Wojnerowicz C, Kycler Z et al: Poznań Cancer Centre 1953–2003. Rep Pract Oncol Radiother, 2003; 8: 85–95
20. Metzger DF. Public – private mix in health and social service policy: lessons learned in the United States. Rep Pract Oncol Radiother, 1999; 4: 25–8
21. Milecki P, Nawrocki S, Malicki J, Stryczyńska G: Evaluation of an electronic portal imaging device (target view, GE) as a quality assurance tool. Rep Pract Oncol Radiother, 2001; 6: 169–72
22. Skowronek J, Zwierzchowski G, Piotrowski T: Pulsed dose brachytherapy – description of a method and a review of clinical applications. Rep Pract Oncol Radiother, 2001; 6: 197–202
23. Smolińska B, Bereza I, Eberhardt B: Soma Vision – new possibilities in computer treatment planning. Rep Pract Oncol Radiother, 2001; 6: 27
24. Żórawska A, Kowalska A, Słuszniak J et al: Assurance of radiological quality protection in surgical procedures. Rep Pract Oncol Radiother, 2004; 9: 51–4