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Review

Pattern of radiotherapy care in Bulgaria

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ABSTRACT

The paper reveals the changing pattern of Bulgarian Radiotherapy (RT) care after the successful implementation of 15 projects for 100 million euro under the European Regional Development Fund in Operational Programme for Regional Development 2007–2013.

The project enables a total one-step modernization of 14 Bulgarian RT Centres and creation of a new one. At the end of the Programme (mid 2015), 16 new Linacs and 2 modern cobalt machines will be available together with 11 virtual CT simulators, 5 CT simulators, 1 MRI and 1 PET CT for RT planning and all dosimetry facilities needed. Such a modernization has moved Bulgarian RT forward, with 2.7 MV units per one million of population (MV/mln.inh) in comparison with 0.9 MV/mln.inh in 2012. Guild of Bulgarian Radiotherapists includes 70 doctors, 46 physicists and 10 engineers, together with 118 RTTs and 114 nurses and they all have treated 16,447 patients in 2013. Major problems are inadequate reimbursement from the monopolistic Health Insurance Fund (900 euro for 3D conformal RT and 1500 euro for IMRT); fragmentation of RT care with 1–2 MV units per Centre; no payment for patient travel expenses; need for quick and profound education of 26% of doctors and 46% of physicists without RT license, along with continuous education for all others; and resource for 5000–9000 more patients to be treated yearly by RT in order to reach 45–50% from current service of 32%. After 15 years of struggle of RT experts, finally the pattern of Bulgarian RT care at 2014–2015 is approaching the level of modern European RT.

1. History of Bulgarian Radiotherapy

Bulgarian Radiotherapy (RT) practice has a long history. It started early, at the beginning of the 20th century in 1906 at the Alexandrovska Hospital in Sofia. Institute of Radiology was founded in 1920, and National Cancer Centre was established in 1934. Medical Radiology Chair was initiated in 1940 for undergraduate and postgraduate education in RT.[1]

2. Cancer care organization

Since 1950 the structure of radiotherapy (RT) service has been integrated in Bulgarian Cancer Hospital Network. RT is offered

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Fig. 1 – Map of RT Centres in Bulgarian Cancer Hospital Net. Big star – National RT Centre and 4 University RT Centres: Sofia, Plovdiv, Varna, Pleven; small star – 10 Regional RT Centres, part of Oncology Dispensaries – Varna, Rousse, Schoumen, Veliko Turnovo, Vratza, Plovdiv, St Zagora, Burgas, Haskovo, Blagoevgrad; MV, cobalt (Co) and brachytherapy units are shown.

nowadays in 16 radiotherapy departments, 15 already established and a new one that has recently started to treat patients. Each of the ten Radiotherapy Departments is a part of Regional Comprehensive Cancer Centre, a cancer hospital with good functional and organizational links called Dispensary (Fig. 1). In 1951, the National Centre of Oncology was founded with a Department of Radiotherapy in its structure. Four other University Radiotherapy Clinics in Sofia, Plovdiv, Pleven and the new one recently opened in Varna, are functioning within the University Multidisciplinary Hospital (Fig. 1). Only one RT department is private, set up in a private multimodality hospital Tokuda, part of a global chain of Japanese private hospitals.

3. Materials and methods

Every year a questionnaire was sent to every department to report its RT activity for the past year. Since 2000, the data have been summarized and presented by the President of the Guild at the regular Annual Meeting. Each report includes the number of patients treated yearly for major tumour sites, radiotherapy techniques used, outpatient and inpatient numbers, radical and palliative treatments, quantity and quality of the staff, reimbursement of different procedures, proposal for improvements, etc. These data have been available in the Guild database since the year 2000 and the recent information for 2013 is used in this paper.

4. Results and discussion

4.1. *Spectrum of radiotherapy for different tumour sites*

Bulgaria has a population of 7,304,632 registered for 2012 with a negative tendency of declining −0.78.[2] A total of 36,649 new cancer cases were recorded in the National Cancer Register report for 2012 (the latest issue).[2] Radiotherapy treatment data for 2013 are shown in Table 1. Patients with major tumour sites are covered by radiotherapy care. Eighty percent of endometrial and uterine cervix cancers were treated by RT/1861 patients out of 2298 new cases (Around 70% of the new patients with breast cancer underwent adjuvant RT/2744 out of 3923 new cases). We still do not have resources to cover all cases having RT indication of the prostate, head and neck and some other cancers. RT pattern of care has been considerably changed with the installation of modern armamentarium. This has resulted in a 15% rise of treated cases, from 13,794 in 2012 to 16,447 in 2013 (Table 2). However, 43% of them (7063) were still irradiated on cobalt machines, mainly by 2D planning, and only 2 Centres have new cobalt facilities with 3D planning (Table 2). Only 26% (4325 patients) of all treatments are provided by 3D conformal RT or IMRT on the four Linacs available in 2013. This is a vast increase in comparison to 1285 patients, irradiated on just 2 Linacs available in 2009. Palliative RT has traditionally been delivered for many years

Table 1 – External beam RT courses, including re-treatment for 2013 for major tumour sites.

Tumour site	Patients treated on Linacs (*n*)	Patients treated on Co units (*n*)	Patients treated on orthovoltage Ro RT (*n*)	All patients on RT (*n*)
Breast cancer	949	1795	0	2744
Cervix and endometrial cancer	574	1287	0	1861
Head and neck cancer	354	607	0	961
Prostate cancer	574	274	0	848
Rectal cancer	312	424	0	736
Brain cancer	226	186	0	412
Bronchus cancer	216	255	0	471
Skin cancer	0	0	1733	1733
All other cancers	834	1114	1095	3043
Palliative cancer RT	286	1121	1785	3192
Total	**4325**	**7063**	**4613**	**16,001**

mainly by orthovoltage equipment (1785 patients) compared to 1121 patients on cobalt machines (Table 1). The lack of modern palliative RT care is illustrated by the figure of only 286 patients irradiated by Linac conformal techniques (Table 1). We still could not provide radiosurgery (RS) and stereotactic body RT (SBRT) for two reasons: no reimbursement and just recent installation of Linacs with RS option.

4.2. *Radiochemotherapy*

Radiochemotherapy (RTCT) nowadays is a routine simultaneous treatment for patients with brain, gynaecological, rectal, anal, head and neck cancer. Recently, we have succeeded to regulate prescription and application of chemotherapeutic and target therapy drugs as a skill and responsibility of radiation oncologists. In this respect, we have resolved the issue that has been reported in other European countries.[3] Bulgarian Radiotherapists do not intend to have a common specialty with medical oncologists, like in Scandinavian countries or England, but we have legitimated our full prescription matter and responsibility for radiochemotherapy and bioradiotherapy. RTCT is still beyond of all patients' needs, but around 600 patients were treated in 2013.

4.3. *Brachytherapy*

Brachytherapy is a neglected RT modality in Bulgaria. In 2013, only 553 patients received brachytherapy and the number has not grown during the last 10 years (Table 2). There was only one HDR brachytherapy facility available, and that far below ESTRO recommendations. This 10-year-old HDR brachytherapy machine is working in RT Department of the National Centre of Oncology, treating 243 patients with intracavitary and 70 patients with interstitial brachytherapy in 2013. Since 2014, as a part of modernization project, one more HDR facility has been installed at the Regional RT Centre in the city of Shoumen (Fig. 1). Important explanation for brachytherapy retardation is the lack of tradition and radiotherapists' motivation to obtain brachytherapy skills. Instead, metabolic brachytherapy with 131-Iodine and 89-Strontium has traditionally been the competence of Bulgarian radiation oncologists, rather than Nuclear Medicine physicians. In 2013, 240 patients were treated by metabolic brachytherapy for thyroid cancer and bone metastases.

4.4. *Special technique*

A new achievement of RT practice is the total body radiotherapy (TBRT) technique, provided as mieloablative or conditioning regime before bone marrow transplantation in some solid tumours and malignant lymphomas. TBRT is now in routine use for children and adults in the University RT department in Sofia.

4.5. *Staff*

Guild of Bulgarian Radiotherapists has 70 physicians and 48 physicists, a number recorded for 2014. Bulgarian RTTs are called "Radiotherapy laborants" and they have their separate organization named Association of Bulgarian Radiotherapists with 117 members. Additionally, 114 radiotherapy nurses are supporting our patients in clinics. New equipment needs more

Table 2 – Number of patients treated by different RT modalities during last 10 years.

Modality	2003[1]	2009[2]	2011[3]	2012[3]	2013[3]	
					N	%
Linac RT	110	1285	3392	3151	4325	26
Cobalt machine RT	6318	8118	6614	7053	7063	43
Orthovoltage RT	2016	3532	3548	3150	4613	28
Brachytherapy incl. metabolic brachytherapy	527	544	484	448	557	3
Total	**8971**	**13,342**	**14,038**	**13,802**	**16,447**	**100**

1, 2003 – 1 Linac; 2, 2009 – 2 Linacs; 3, 2011–2013 – 4 Linacs.

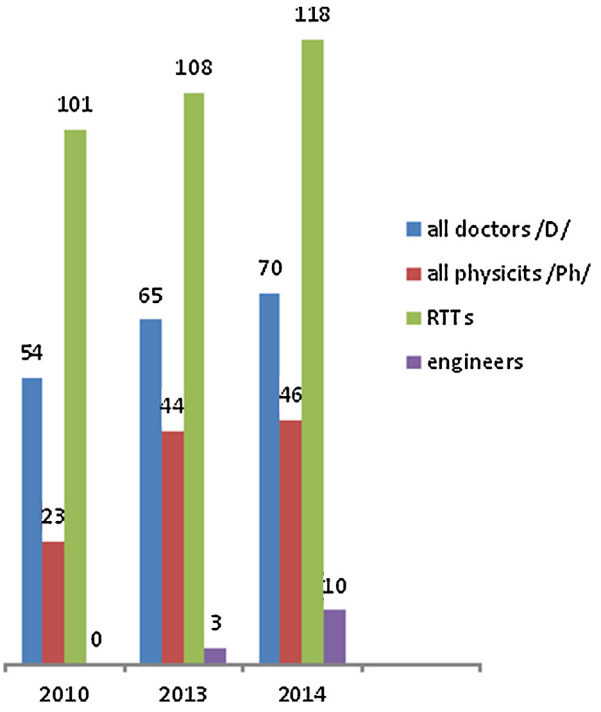


Fig. 2 – Radiotherapy staff from 2010 to 2014.

staff and positive tendency is seen in Fig. 2. The staff workload is very different, according to Centre's level, practicing different techniques and additional academic engagement (Fig. 3). The average number of patients treated per year by a physician is 142 (range 106–336) (Fig. 4). Those with additional academic duties have lower patient workloads. The busiest staff member is the physicist with an average workload of 326 planning per year and big variations from 733 to 195, depending on irradiation complexity (Figs. 3 and 4). RTTs irradiate on average 207 patients per year (165–336). In new Medical Standard for Radiotherapy a maximum workload of 200 patients per year was fixed to avoid possible mistakes in complicated procedures (Fig. 4.

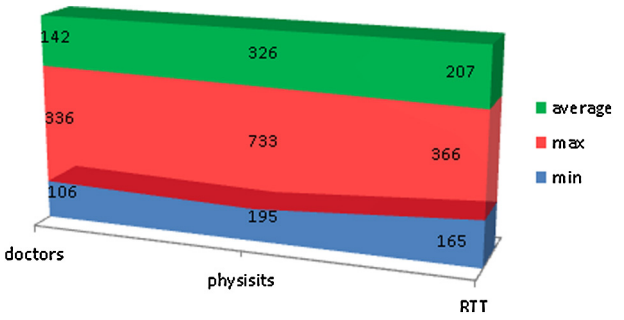
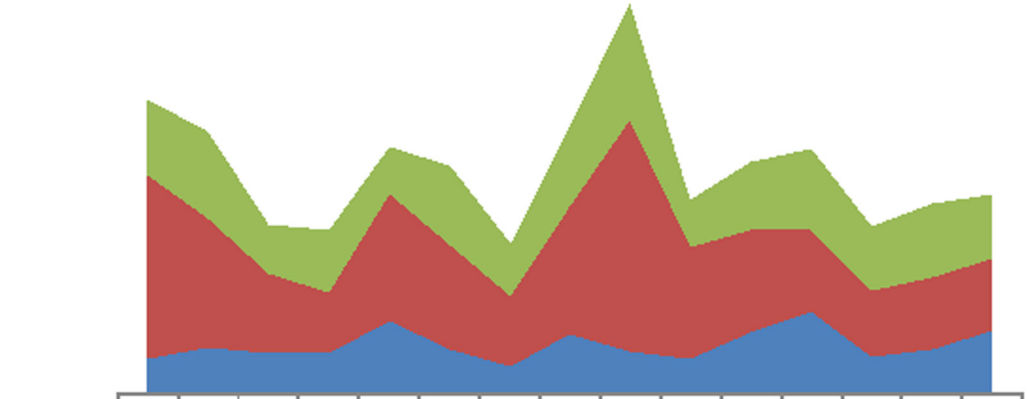


Fig. 4 – Average, minimum and maximum workflow of the different staff according to duties and techniques.

4.6. *Infrastructure levels of RT centres, accreditation requirements*

Radiotherapy care is provided in 15 established RT departments (Fig. 1). The new one at the University Hospital Varna was recently opened in April 2015. According to freshly updated document "Medical Standard Radiotherapy", all RT Centres have been classified into 3 levels (Table 3). The document has a binding force and serves for accreditation and audit purposes. RT department at the National Centre of Oncology and two University RT departments in Sofia and one in Plovdiv, each as a part of multimodality big hospital were certified to the highest 3rd level. They have to be capable of providing several RT duties – external beam radiotherapy with 3D conformal and IMRT, with IGRT as an option; brachytherapy with sealed and/or unsealed radioactive sources and to educate medical students and postgraduate fellows. Minimal requirements for the 3rd level staff are: 6 doctors (at least 3 with RT license); 4 physicists (at least 1 with medical dosimetry license) and 8 RTTS. The patient workflow has to be minimum 800 patients per year. We do not set a requirement for the number of machines per Centre, but we use such criteria as availability of different radiotherapy modalities, quantity and skills of the staff, and numbers of treatments per year. Second



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
RTT	239	271	155	195	150	250	165	255	366	145	218	259	209	231	201
phys	582	407	248	195	400	333	220	401	733	356	321	259	209	231	230
doctors	110	150	132	128	235	140	90	188	135	112	197	259	116	140	200

Fig. 3 – Workflow for Radiotherapy staff in each of 15 Centres.

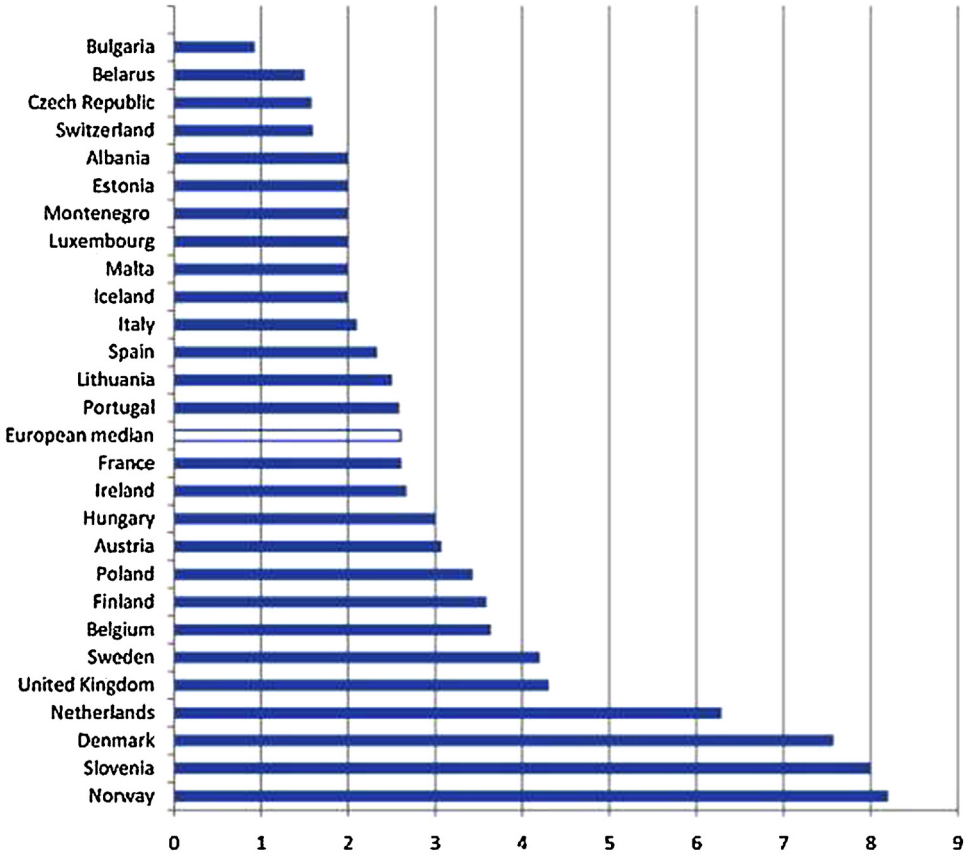


Fig. 5 – Place of Bulgaria in histogram showing the average number of radiotherapy treatment machines (MV units) per department in 27 European countries[4,5] (*with courtesy from Radiotherapy and Oncology*).

Table 3 – Levels of accreditation according requirements of Medical Standard "Radiotherapy".

Level	RT activity and armamentarium	Staff	Minimal number of patients treated yearly	RT Centre
3rd level	3D conformal RT IMRT (VMAT), IGRT (optional) on Linac RS or SBRT preferable not obligative brachytherapy on HDR machine, orthovoltage X-ray therapy (optional)	6 doctors (*minimum 3 with RT license*) 4 physicists (*min 1 with medical dosimetry license*) 8 RTTs	800	4 Centres: RT Department in National Centre of Oncology; 3 University RT Dept in major cities – Sofia, Plovdiv, Varna
2nd level	3D conformal RT (IMRT, optional) on Linac or 3D RT on 60 Co machine, orthovoltage X-ray therapy (optional)	3 doctors (*min 2 with RT license*) 2 physicists (*min 1 with medical dosimetry license*) 6 RTTs	500	8 RT Centres in Regional Cancer Centre (dispensary); 1 private RT Centre; 1 RT in UH Pleven (undeveloped)
1st level/supplementary Centre	2D RT for skin cancer, palliative RT, inflammatory RT for degenerative disease on Co machine and/or orthovoltage X-ray therapy	2 doctors (*min 1 with RT license*) 1 licensed physicist 2 RTTs.	200	2 RT Centres in Regional Oncological Centre (dispensary)

level certified Centre is usually situated in a Regional Oncological Dispensary. To fulfil the requirement, such a Centre needs minimum 3 doctors (at least 1 with RT license), 2 physicists (at least 1 with medical dosimetry license) and 6 RTTs. The Centre has to be capable of offering at least one RT modality with high energy EBRT with 3D conformal RT for minimum 500 patients per year (Table 3). The lowest (first) level RT Centre is called 'supplementary Centre', but it is different from a so-called satellite Centre in Europe. The requirement for the staff number is 2 doctors (1 with RT license), 1 licensed physicist and 2 RTTs. They have to be skilled to deliver RT treatment **on its own responsibility** by 2D panning on cobalt machine and orthovoltage RTG facility only for skin cancer, palliation and anti-inflammatory RT for degenerative disease. Minimum patient workflow has to be 200 cases per year. Only 2 out of all the Centres are classified as 1st level. They are also part of Cancer Dispensary. Such a low level of RT is still accepted, because some patients could not afford travelling every day longer distance without reimbursement of travel expenses, which the Health Insurance System does not pay. Probably, with further modernization of equipment, those supplementary Centres will move to 2nd level (Table 3).

4.7. *Modernization of Bulgarian RT care*

Since 2012 big changes started in RT practice using Regional Development Projects from the European Union Programme. With the EU support of 100 million euro (with 15% co-financing from the Bulgarian budget) all 14 RT Centres in state and regional hospitals have had their armamentarium renewed (Table 4, Fig. 1). Additionally, one new RT department with 3 Linacs has been organized at the University Hospital Varna, the third biggest Bulgarian city with developed cancer care practice. All projects have been approved and financed. Only the private RT department in Tokuda Hospital has not been modernized. Total armamentarium by mid 2015 (end of the projects) will be as follows (Table 4):

- 20 Linacs all equipped with multileaf collimator: 2/20 are 6 MeV monomodal Linacs; 18/20 are multimodal Linacs; 3 of 18 multimodal Linacs have radiosurgery (RS) or stereotactic body radiotherapy (SBRT) facility
- 9 Co units, 4 of them are new with 3D irradiation capability; the remaining old 5 machines are used for palliation only.
- 2 HDR brachytherapy units (1 is new)
- CT simulators, 11 virtual CT simulators (6 of them with cone beam CT)
- 1 MRI for RT planning
- 1 PET CT for diagnostics and RT planning
- 12 orthovoltage RT machines 100–300 keV (not within the projects)

4.8. *Why modernization was done so late?*

It is a shame to say that during the last 15 years the Bulgarian Ministry of Health, politicians and decision makers, have not taken RT as one of the priorities in cancer care, despite continuous pressure from RT experts. We have created several variants of RT modernization programme and have been constantly proposing them to the Ministry of Health. None of these drafts have been accepted during the last 15 years, probably because renovation needs a big investment and such large funds have frightened the politicians. A comparison of Bulgarian Gross National Income (GNI) per capita with GNIs of other European counties could give some explanation of such a sad situation. Bulgaria has one of the lowest GNI figure – 6640$ per capita in comparison with median GNI of European countries. Even the former communist states have bigger GNI (Table 5, second column).[4] We were very impressed by the achievement of our Polish colleagues, being able to push a governmental programme for 715 million euro, allocated for the years 2006–2015.[6]Modernization became possible only after Bulgaria entered the European Community in 2007. Four years later, we succeeded to join the European Union Programme for Regional Development with 15 projects for 100 million euro.

Recently published ESTRO-HERO survey about availability of RT guidelines states their uniformity across Europe.[4] Bulgaria has a Guideline that is officially named 'Medical Standard Radiotherapy', a mandatory term required by the Ministry of Health. The standard classifies all 16 RT Centres into three categories according to the level of RT techniques available, staff number, skills and academical duties. The quantity of armamentarium per Centre was not included as a parameter for stratification, because RT modernization is a very recent fact. Table 4 shows that only 5 Departments will have more than one Linac after the completion of the EU Project. Two departments have a new 3D cobalt machine in addition to a Linac. Thus, 9 Centres will remain with only one Linac or modern Co facility. This wrong policy was adopted by the Government in power in 2011 during project application, despite extensive objection of RT experts. It is well known that concentration of machines per Centre is much more cost-effective. However, recent HERO results show that in 8 countries (Malta, Switzerland, Iceland, Ireland, Spain, Czech Republic and Bulgaria), such a fragmentation of radiotherapy services exists and potentially influences treatment quality and efficacy.[5] Paradoxically, in Bulgaria shortage of money and regional municipalities' struggling for at least one new machine per Centre were reasons for such an irrational choice. Another local authority argument was the lack of transport reimbursement, which limits accessibility to RT care. So, ESTRO HERO survey have positioned Bulgaria on the last place in Europe (0.9 per Centre – data for 2012, Fig. 5), citing 2.6 as median number of treatment machines per European department, with a range from 0.9 to 8 (Fig. 3).[3] After the implementation of all projects at mid 2015 Bulgarian such figure will be 1.6 MV unit/per department.

An important parameter for RT pattern of care is the number of RT treatment facilities per million of population. Even after the end of the modernization process, Bulgaria will remain with a figure of 2.7 Linacs per 1 million of population. Countries with high GNI as Denmark (60,160 euro per capita) have 9.6 Linacs per 1 million of population and 8–9 Linacs in a department, 94% of them are new generation machines (Table 5, Fig. 6).[4] Ranked in the middle are countries as Germany, France with 5–6 Linacs and United Kingdom and Spain with 4.7–4.9 Linacs per 1 million people (Fig. 6).[4] We need to put more pressure on Health authorities to reach at least the level of the Check Republic – 4.1 Linacs,[7] Poland – 3.2 Linacs[6] or Hungary – 3.6 Linacs per million population (Table 5,

Table 4 – Armamentarium changes during 2010–2014.

Centre	Available armamentarium up to 2010	Armamentarium after end of all projects 2010 to mid 2015
1. RT Department in National Centre of Oncology	1 MM[1] LINAC 1 Co unit[2] – 3D planning 1 HDR brachytherapy 1 orthovoltage RT 300 keV CT simulator	3 MM Linacs + 2 IMRT 1 Co unit – 3D planning 1 HDR brachytherapy 1 orthovoltage RT 300 keV 1 CBCT[4] 1 MRT for planning
2. UH RT Department, Sofia University	1 MM Linac 1 Co unit 1 orthovoltage RT 250 keV Diagnostic CT for planning	2 MM Linacs + IMRT, IGRT 1 with SRS option 1 CBCT Orthovoltage RT 250 keV
3. UH RT Department, Plovdiv University	1 MM Linac 1 orthovoltage RT 300 keV 1 Co unit Diagnostic CT for planning	2 MM Linacs (1 for IMRT) 1 CBCT PET CT for planning
4. UH RT Department, Varna University **New Centre – 2014**	No RT Dept	3 MM Linacs: 2 with IMRT + 1 with SRS option 1 CBCT Diagnostic PET CT
5. RT Department Private Hospital Tokuda, Sofia	1 MM Linac + IMRT + SRS option 1 Virtual CT	Not in the project
6. Regional RT Centre Shoumen	1 Co unit Diagnostic CT 1 orthovoltage RT 250 keV	2 MM Linacs[2] + IMRT 1 HDR brachytherapy 1 CBCT 1 orthovoltage RT 250 keV 1 Co unit[3] 2D planning
7. Regional RT Centre Ruse	1 Co unit – 3D planning Diagnostic CT for planning 1 orthovoltage RT 300 keV	1 MM Linac + IMRT 1 CB CT 1 orthovoltage RT 250 keV 1 Co unit – 3D planning
8. Regional RT Centre Vratza	1 Co unit Diagnostic CT for planning 1 orthovoltage RT 300 keV	1 MM Linac + IMRT 1 CBCT 1 orthovoltage RT 250 keV 1 Co unit 2D planning
9. Regional RT Centre Veliko Turnovo	1 Co unit Diagnostic CT for planning 1 orthovoltage RT 300 keV	1 MM LINAC 1 CBCT 1 orthovoltage RT 250 keV
10. Regional RT Centre Varna	1 Co unit Diagnostic CT for planning 1 orthovoltage RT 250 keV	1 MM Linac +IMRT 1 CBCT 1 orthovoltage RT 250 keV 1 Co unit 2D planning
11. Regional RT Centre Plovdiv	1 Co unit Diagnostic CT for planning	1 MM Linac 1 simulator
12. Regional RT Centre St Zagora	1 Co unit Diagnostic CT for planning 1 RT 250 keV	1 MM Linac + IMRT 1 CBCT 1 RT 250 keV 1 Co unit – 3D planning
13. Regional RT Centre Burgas	1 Co unit Diagnostic CT for planning 1 RT 250 keV	1 MM Linac + IMRT 1 CBCT 1 RT 250 keV 1 Co unit – 2D planning
14. Regional RT Centre Blaroevgrad	1 RT 250 keV	1 Co unit – 3D planning 1 CT simulator 1 RT 250 keV
15. Regional RT Centre Haskovo	1 RT 250 keV	1 Co unit – 3D planning 1 CT simulator 1 RT 250 keV

Table 4 (*Continued*)

Centre	Available armamentarium up to 2010	Armamentarium after end of all projects 2010 to mid 2015
16. RT Centre in Oncological Centre Pleven University	1 RT 250 keV	1 MM Linac 1 CT simulator 1 RT 250 keV
Total	**Total armamentarium available up to 2010**	**Armamentarium after the end of EC project – mid 2015**
16 Centres	4 Linac, 12 Co units – 2 with 3D planning, 1 brachytherapy unit, 2 CT simulators, 10 Diagnostic CT for planning, 13 RT machines 250–300 keV	18 MM Linac[1], 2 Mono M Linac[2] 9 Co units[3] (4 with 3D planning) 2 HDR brachytherapy units 5 CT simulators 11 CBCT simulators[4] 1 MRI for RT planning 1 PET CT for RT planning 12 100–300 keV RT machines

1, MM Linac – multimodality Linac; 2, Mono M Linac – Linac with one energy 6 MeV; 3, Co unit – cobalt 60 unit; 4, cone beam CT simulators.

Fig. 6).[4,5] Comparison of Bulgarian Radiotherapy practice with that of Latin America still favours our European status.[8,9] The advantage of one-step modernization in Bulgaria is that 86% of Linacs are with IMRT options as compared to former communist countries (Table 5).

We are not discussing the number of simulators, because the financial resources available under the projects put a limit of one simulator per department. All 11 RT Centres with IMRT option have virtual CT simulators with CBCT. The other 5 have simple CT simulators. Big achievement is magnetic resonance imaging (MRI) for planning, supplied for RT Department at the National Centre for Oncology. Special PET CT imaging for RT as well as for diagnostics will be available only at the University RT Centre in Plovdiv (Table 4). For information, in Bulgaria there are only 2 PET CT machines. They are used for all diagnostic purposes needed and additionally for staging/restaging cancer patients.

IMRT techniques including VMAT will be possible on 16 of 20 newly installed Linacs by mid 2015. This technique needs time and new skills of the staff, so in 2014 only 5 Departments routinely perform IMRT. IGRT is still in a process of establishment and will be provided at the University RT Departments and 2 Regional RT Centres (Table 4).

Bulgaria is one of the best examples that the availability of financial resources at the national level is the main determinant of RT care. According to HERO 2014 cluster analysis, performed on three variables (% IMRT, MV units/n and GNI) Bulgaria has been positioned in the fourth cluster, together with Central – Eastern European Countries (Estonia, Poland, Slovenia, Check Republic, Hungary, Lithuania, Belarus plus Malta and Portugal, Fig. 7.[5] It is important to note the considerable differences within such a cluster: mean GNI/n is 13.4 mln., but 6.4 for Bulgaria; average number of MV units installed per million population is 3.4 (but 2.7 for Bulgaria) and the only higher figure for Bulgaria RT is 85% of IMRT capability, compared to the mean percentage of 41.8%. Ahead are all the other European countries, so we have to work further to reach the level of the rest of European departments (Fig. 7).

4.9. *Cancer patients coverage by RT*

National Cancer Register has reported 34,864 new cases for 2011 with a 94% confidence interval, thus, the real number of new cases is probably 36,180.[2] In 2011, 14,152 patients received RT. Assuming that 20% of them have been re-radiated (by palliative RT), the percent RT coverage of new cases is 32%. We

Table 5 – Comparison of General National Income (GNI) per capita and number of RT machine per 1 mln. inhabitants in different European counties, maximum, minimum availability and Denmark as an example of highest number of machines with highest percentage IMRT (selected data from HERO project).[4,5]

Country	GNI/n $	Linacs per 1 mln. population	% Linacs + IMRT of all Linacs
Check Republic	18,720	4.1	67
Slovenia	23,940	4.0	62
Hungary	12,840	3.6	60
Lithuania	13,000	3.3	33
Poland	13,000	3.2	89
Estonia	15,260	3.0	100
Bulgaria	**6640**	**2.7**	**84**
Belarus	6270	0.8	62
Max in Europe	88,500	5.4	42
Med in Europe	**36,550**	5.1	73
Denmark[1]	60,160	9.6	94

1, highest ratio in Europe.

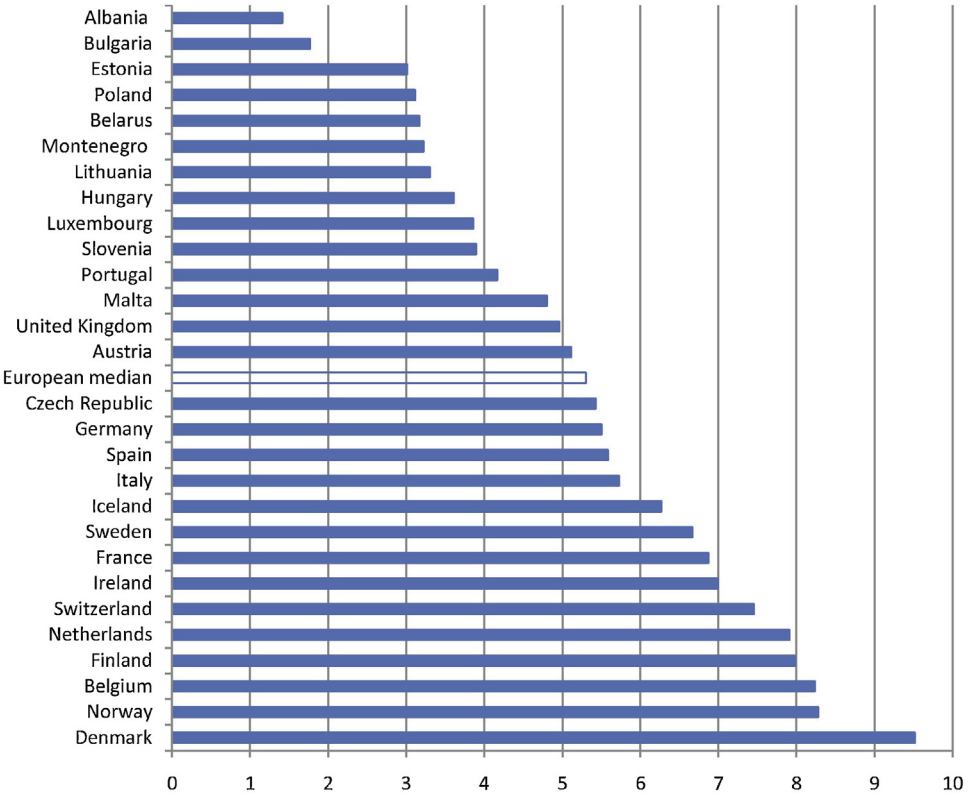


Fig. 6 – Place of Bulgaria in histogram showing the average number of radiotherapy treatment machines (MV units) per million inhabitants in 28 European countries[4,5] (*with courtesy from Radiotherapy and Oncology*).

are far below the average RT needs of 45–50% reported by the European Society for Radiation Oncology (ESTRO) and 70% proposed by the Organization of European Cancer Institutes (OECI).[10,11] This comparison reveals that RT care is insufficient for 5000–9000 Bulgarian patients yearly!

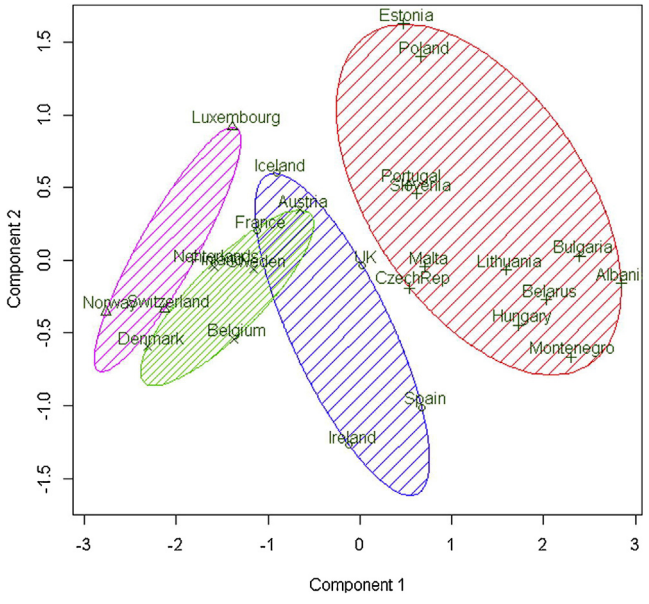


Fig. 7 – Cluster analysis based on 3 main variables/% IMRT, MV unit/ml inhabitants and GNI/n[4,5] (*with courtesy from Radiotherapy and Oncology*).

The main tumour sites are covered by RT services around the country. Evidence based medicine achievements as preoperative or organ saving radiochemotherapy are implemented in the routine practice. Whole body RT is provided as mieloablative or conditioning regime before bone marrow transplantation in some solid tumours and malignant lymphomas for children and adults. Radiosurgery (RS) and stereotactic body radiotherapy (SBRT) are not yet available, but in mid 2015 those will be put into practice. RT Problematic tumour sites, such as gastric, pancreatic and hepatic and some rare cancer types are not within the main scope of our routine RT at the moment. We do believe that a further task after establishing modern IMRT, IGRT and RS will be to provide RT for patients with these tumours. Additional burden for the staff is to cope with patients stress explaining why we are not treating them with radiotherapy as in other European countries.[12]

4.10. *Do we have financial resources for RT care improvement? Level of reimbursement*

Since 1999, the Bulgarian Health Care has been included in the obligatory public Health Insurance System, financed by only one (monopolistic) National Health Insurance Fund. Reimbursement for radiotherapy started in 1999 has been continuously extended to include more and more RT procedures. Nevertheless, even after many years of negotiations with the Fund, RT reimbursement covers only 25–50% of the real running costs and expenses in the field.

There is only one private RT Centre as a part of Tokuda Japanese private hospital. Bulgaria may the only country where RT is not a profitable medical procedure, despite the lack of modern equipment and only 32% RT coverage. The major reason is low and inadequate reimbursement of RT. It is certainly due to the lack of fair competition due to the Health Insurance Policy. National Health Insurance Fund is still a monopolist organization. No other Health Insurance Funds were allowed to work with hospitals despite long years of debate among politicians. Reimbursement for three-dimensional conformal RT is 1820 Bg leva – around 900 euro!?. Reimbursement for IMRT techniques is only 1500 euro. There is no reimbursement for RS or SBRT, so we do not provide the procedure, despite the upcoming technical availability. Such an insufficient reimbursement creates hospital dept and cuts down local hospital initiative for equipment replacement. RT is a lucrative modality in all countries, except Bulgaria where health care authorities make it non-profitable.[13] It is really very difficult to be a high level RT expert and to fight for the future in such difficult political environment, where no scientific or social arguments seem to be working.

4.11. *Education and expertise of the staff*

University departments in Sofia, Varna and Plovdiv are responsible for medical and dental student education in a common discipline together with Radiology and Nuclear Medicine. University RT department situated in UH "Queen Giovanna" in Sofia is a leading institution organizing postgraduate education for doctors and RT modules for medical physicists. Upgraded ESTRO curriculum has served as an example[14] and the postgraduate education programme was upgraded in 2014. Teaching and expertise is provided by 5 full professors (2 in Sofia University, one in Plovdiv University, one at the National Centre of Oncology, one in Varna Regional Centre) and 2 associate professors – one in Varna University and one at the Regional Shumen Department. There is a significant increase in employment of RT staff during the modernization period of 2013–2014. From 2012 to 2014, a number of doctors have risen from 52 to 70 and the number of medical physicists from 23 to 46 (Fig. 2). Fifty doctors and 25 physicists have RT license. Armamentarium modernization creates high need and challenges for new staff. In the next 2–3 years we have to educate for RT license more than 25% of the doctors and more than 46% of all the physicists (Fig. 8). Facing the same problems as our colleagues16 we have to resolve them quicker because of the vast one step modernization.[15] Despite the offered discount fee for ESTRO courses, it is still financially difficult for our physicians and physicists to join them. Instead, we are organizing short one-week courses mainly at our University Departments or in National Centre of Oncology. Moreover, individual weekly training is now provided in the newly modernized Centres as continuous education. Yearly, several evidence based medicine multidisciplinary symposiums or workshops are organized in the country, promoting modern RT information. RTTs do not have separate RT specialization after their main radiological education, so their training is mainly held on-sit. Association of Bulgarian RTTs starts organizing training courses on behalf of ESTRO. Further efforts are required to educate 118 RTTs with the newest techniques; therefore, future regulatory changes in RTTs basic education are essential.

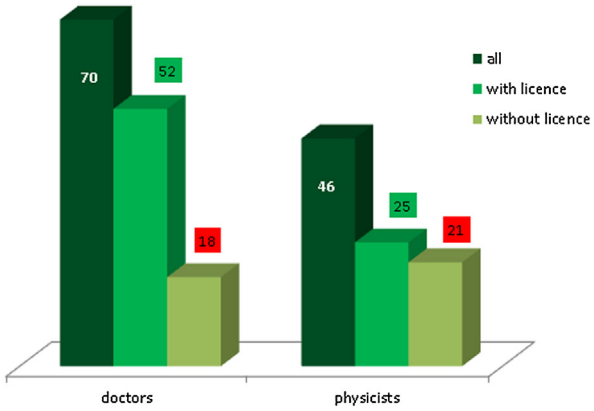


Fig. 8 – Postgraduate education needs after modernization period (status in 2014).

Table 6 – Available armamentarium in Bulgaria (mid 2015) in comparison with megavoltage machines available in other formal socialistic countries (selected data from HERO project).[4,5]

Country	Reference years	Population	RT Centres (*n*)	Megavoltage machines				
				Total MV units incl. Co machines	Linacs	L + IMRT	L + IGRT	Dedicated SRS
Belarus	2009	9,671,192	20	30	8	5	4	0
Check Republic	2009	10,491,492	36	57	43	29	17	4
Estonia	2012	1,340,675	2	4	4	4	4	0
Hungary	2011	10,014,324	12	36	26	6	2	1
Lithuania	2011	3,052,588	4	11	10	3	2	1
Poland	2010	38,529,866	35	127	122	109	77	1
Slovenia	2012	2,058,000	1	8	8	5	3	0
Bulgaria	**2012**[1]	**7,252,041**	**14**	**16**	**4**	**2**	**0**	**0**
	2014		**16**	**27**	**20**	**15**	**15**	**2 in Linac**
	2015[2]							

1, data from HERO project are up to 2012; 2, data after total realization of the EU Project mid 2015.

The forum of GBRT is the Annual meeting where we discuss a wide spectrum of problems. Among issues raised was the main guideline (standard) for RT as a modality and special guidelines for main tumour sites (breast, gynaecological, urological, rectal and anal, head and neck, thyroid cancer, seminoma, etc.). After being discussed at the meetings and finally accepted with consensus by the members, they are published in paper copies and are subsequently are on the Guild website every year. Other topics of discussions are as follows: major organization problems, RT reimbursement policy, upgrade of postgraduate programme for different staff, scientific and technical news, etc.

5. Highlights

Up to 2012, Bulgarian RT care was provided on the last century level. Guild of Bulgarian Radiotherapists finally has won the battle with the Health Care Authorities and implemented 15 projects under the European Community for Regional Development, obtaining 100 million euro with 15% Bulgarian contribution. Bulgarian RT now is approaching the level of modern RT care. There is a slight inadequacy in the HERO survey data for the contemporary level of Bulgarian RT among the other European countries. In the HERO analysis, Bulgarian RT status is shown at the level of the year 2012.[4,5] During 2013–2014, 16 new Linacs and 2 modern cobalt machines have been planned, more than 13 were already installed and other 4 will be installed by mid 2015, reaching the number of 20 Linacs and 9 cobalt machines (Table 4). This will put Bulgarian RT pattern of care up in comparison to the other EU counties (Tables 5 and 6). Such a total one step modernization is very challenging – 26% of doctors and 46% of physicists are newly appointed and have to be educated to receive appropriate license. All RTTs and other medical staff need continuous RT education. More efforts are required to continue the modernization process finding extra resources at least to duplicate Linacs in every Centre. The “epic battle” will continue for real reimbursement to provide a whole spectrum of RT for all patients with RT indication during their course of disease and to have resources to irradiate 5000–9000 more patients. The best way to convince Bulgarian decision makers is to show them how the “European optimal level of provision looks like” as the authors of ESTRO HERO Project has stated.[4,5]

Conflict of interest

None declared.

Financial disclosure

None declared.

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