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Research Note

Proton therapy for head and neck cancer therapy: A real-world data case study from Bulgaria

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Abstract

Head and neck cancers (HNC) are one of the most severe types of cancer in Europe, accounting for almost 4.5% of all cancer types, according to GLOBOCAN. The incidence is geographically variable, with higher rates observed in Eastern and Southern Europe than in Northern and Western Europe. Proton and photon therapies are both available treatment approaches for head and neck cancer, as each has its own unique advantages, characteristics, and considerations. Proton therapy is the newest one and is considered safer among both. The current study aims to analyse the available data for patients with head and neck cancer treated with proton therapy in Bulgaria based on real-world data generated through AI-based patient registries and the current availability of strategic policy documents ensuring the affordability of proton therapy on a national level. We wanted to explore the feasibility of building a national proton therapy centre based on available patients' information and strategic policy documents. We conducted a 3-year (2020–2022) combined non-interventional retrospective database study on head and neck cancer using secondary use of real-world data from dynamic patient registries and desktop analysis of strategic policy documents for capacity and financial affordability for proton therapy in Bulgaria. The results show that Bulgaria has a strategic policy document that focuses on the need and funding possibilities for establishing this treatment within the country. However, the country lacks the political will to ensure appropriate funding for it. Building a national proton centre is a feasible investment but needs additional detailed budget impact analysis.

Keywords

head and neck cancer, proton therapy, inequity, market access, affordability

Introduction

Head and neck cancers (HNC) are one of the most severe types of cancer in Europe, accounting for almost 4.5% of all cancer types, according to GLOBOCAN. The incidence shows geographical variation, with higher rates observed in Eastern and Southern Europe than in Northern and Western Europe. (Barsouk et al. 2023) The most common causes of HNC are attributed to increased alcohol and tobacco consumption. Still, in recent years, human papillomavirus (HPV), mainly subtype 16, has shown an increasing tendency to be the leading cause (Gillison et al. 2015).

Bulgaria is not an exemption from the world's tendencies about cancer incidence and mortality. The cancer incidence increased from 32065 to 35990 cases, and the mortality increased from 16,79 to 17969 cases during

2004–2024 (Valerianova et al. 2017). The incidence of laryngeal cancer is 3.3% of all cancer types in the male population. In 2014, there were 1051 new cases of head cancer and 102 oropharyngeal cases.

The choice between both depends on tumour and patient characteristics, treatment goals, market accessibility, and financial affordability. A multidisciplinary team, including radiation oncologists, medical physicists, and other specialists, is needed to evaluate each patient's case and determine the most suitable treatment approach (Blanchard et al. 2018).

Despite their efficacy, proton and photon therapies (PT) are challenged across Europe and are still considered a resource-limited approach. The reason behind these is attributed to logistic and economic factors such as the low number of available facilities around Europe, especially in Central and Eastern European countries. Proton and photon therapies are both available treatment approaches for head and neck cancer, as each option has its own unique advantages, characteristics, and considerations. Proton therapy is the newest one and is considered safer than photon therapy, with the cost of construction, maintenance, training of specialists, and public coverage limitations (Grau et al. 2020). The latter is the main cause of inequity in PT-treated head and neck cancer patients across Europe (Nogueira et al. 2022).

In Bulgaria, 600 patients a year need proton therapy, and 50% of the eligible patients who will benefit from PT are children. Currently, they are treated either with conventional CT or in foreign oncology centres (mostly children). According to healthcare experts, the average cost per patient for PT therapy is approximately €20,000 per procedure, and children are prioritised.

The cost is covered only for children by the National Health Insurance Fund (NHIF) and paid for by Bulgaria for hospitals abroad. Recently, Bulgaria started a debate about the necessity of building proton therapy centres that provoked our interest in the topic.

The current study aims to explore the feasibility of building a national proton therapy centre based on an analysis of the available information for patients with head and neck cancer treated with proton therapy in Bulgaria based on real-world data generated through AI-based patient registries and the current availability of strategic policy documents ensuring the affordability of proton therapy on a national level.

Methods and materials

Study design

We conducted a 3-year (2020–2022) combined non-interventional retrospective database study on head and neck cancer using secondary use of real-world data from dynamic patient registries and desktop analysis of strategic policy documents for capacity and financial affordability for proton therapy in Bulgaria.

Data collection and analysis of patients' characteristics and treatment patterns were conducted using the Danny Platform (Sqilline Health, Sofia, Bulgaria; https://sqilline.com/products/danny-platform/). This analytics platform integrates massive amounts of real-world data (RWD), primarily from electronic health records (EHRs), with embedded machine learning (ML) and natural language processing (NLP) algorithms. These algorithms automatically extract free-text data from different languages, ensuring high data quality. As a result, Danny Platform provides secure access to curated sets of aggregated, de-identified data from hospital information systems (HIS). Because the data collection and analysis process exclude direct patient involvement and does not require safety reconciliation, informed consent was not needed for this study.

The desktop analysis was based on a review of published strategic policy documents for the construction, logistics, and financial coverage of proton therapy in Bulgaria.

Study population and outcomes

The study population considered in this study is all PT-eligible head and neck cancer patients diagnosed and treated during the period of data collection (2020–2022). For the selected cohort of patients, we collected demographic data and data for the duration and location of proton therapy and concomitant chemotherapy.

Desktop analysis of strategic policy documents

We searched several publicly available databases and strategic documents. The national cancer registry was searched for information about the burden of various head and neck cancer pathologies. The Ministry of Health (MoH) and the National Health Insurance Fund (NHIF) databases were searched for published strategic documents for capacity building of PT facilities, trained specialists, and funding of proton therapy, respectively. These databases were compared with the existing information about the necessary financial and other resources for capacity building at the proton therapy centre.

Uncertainty data was analysed through descriptive statistics.

Results

Patients' characteristics

For the observed period among those diagnosed with head and neck cancer (ICD C71.6 and C76), only 10 children were transferred to PT therapy (eight males and two females) in foreign hospitals. The average age of the patients' cohort was 9.8 years (Table 1).

Bulgaria has no proton centre, and the patients eligible for PT are directed to centres in other countries—Germany, Italy, Austria, and Russia. The distribution of patients among the foreign centres is presented in Fig. 1.

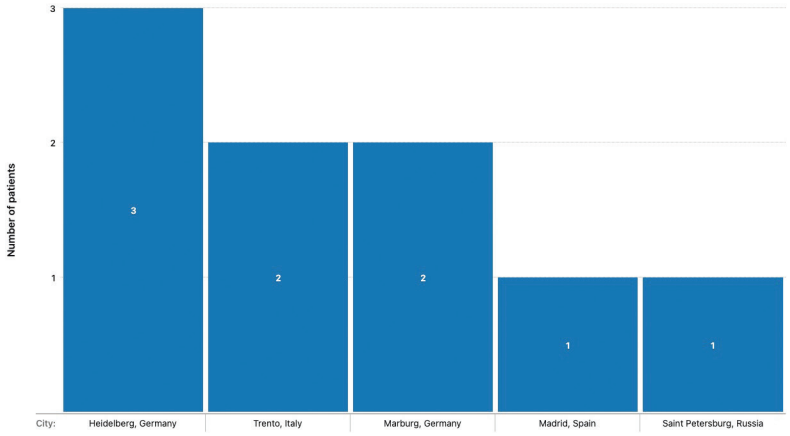

Figure 1. Distribution of foreign centres to which Bulgarian patients with head and neck cancer were assigned to PT therapy.

Table 1. Patients and therapy characteristics.

Input data	No of patients
Cancer type	
Total number of HNC patients on PT	10
ICD C76	3
ICD C71.6	7
Average age	9.8 (SD 4.76)
Gender	
Male	8
Female	2
Chemotherapy	
Concomitant	8 (80%)
Sequential	1 (10%)
No chemo	1 (10%)
Surgical treatment	
Yes	5 (50%)
No	5 (50%)

Desktop analysis of strategic policy documents

The desktop analysis found only one strategic policy document with a focus on proton therapy capacity building. One of the main policies included in the National Health Strategy 2030 focuses on the restructuring and technological development of hospital care. The policy is based on the World Health Organisation's strategy on the importance of establishing affordable and innovative hospital care (Ministry of Health 2022). Together with the priorities set in the National Anticancer Plan, the strategy aims at establishing timely access to modern methods of diagnosis and treatment that follow the principles of personalised healthcare and an integrated multidisciplinary approach. An important part of the plan will also focus on cancer-specific care populations, including childhood cancers, rare tumours, and malignant tumours of the haematopoietic system.

We summarised the results from the desktop analysis in Table 2.

According to the analysis, there is a strategic plan in place for the establishment of a proton centre in Bulgaria, along with trained specialists. However, the project currently lacks funding as it has been deemed too risky for inclusion in the Recovery and Sustainability Plan, which aims to complete projects by 2026.

There are published estimations that the initial investment in a proton centre costs between US$25 million and US$200 million in terms of construction and equipment expenses. (CADTH 2017) Adding the educational costs for personnel, travel, and hospitalisation costs might lead to a total need of US$300 million. The average cost per patient is reported to be nearly US$200,000 in Canada. The average cost per patient in Europe varies between €40,000 and €70,000 (Ramaekers et al. 2013; Chen et al. 2023).

Deciding on such an investment will require a long-term approach and more detailed calculations on the eligible patients, all necessary investment costs, and the possibility of covering international visitors.

Discussion

To our knowledge, this is the first feasibility estimation based on real-world data assessing the need for proton therapy in patients with head and neck cancer in Bulgaria.

The Ministry of Health has established a policy strategy for the proton centre in Bulgaria, but funding remains the most critical barrier to accomplishing the project.

Table 2. Summarised results from the desktop analysis.

	Framework	Strategic document	Availability of capacity building	Trained specialists	Funding	Challenges
Proton Therapy	Project for proton beam centre developed by oncologists, radiologists and patient organizations	National Health Strategy 2030	Existing oncology facilities in Sofia	Yes	Investments in the Recovery and Sustainability	At the end of 2023, the project was cut from the Recovery and Sustainability Plan

At present, proton therapy is only accessible to a limited number of patients abroad, mostly children whose treatment is covered by the National Health Insurance Fund. However, the funding only covers the direct cost of proton therapy, while other expenses such as transportation, the cost of carers, and the duration of the stay abroad are paid out of pocket by the patient's families. Building a national centre will save resources and improve innovative care treatments in the country.

Our study confirms already-published data showing that PT is still considered a resource-limited approach because of the small number of available facilities. Mazzola et al. conducted a review of 10 European facilities (Mazzola et al. 2023). The results show that 10–30% of the patients in these facilities are children, and treatment is covered by the respective national health insurance fund. The analysis also shows that inequity exists among different countries as additional expenditures such as logistics and meal support are not covered by all funds.

In their review, Bergfeldt K. et al. emphasise the need for improved access to proton centres across Europe. This will stimulate scientific collaboration, exchange good practices, and offer better access to patients (Bergfeldt et al. 2020).

In 2023, Bharathi P. and colleagues conducted a systematic review on the economic burden of proton therapy in head and neck cancer. Their findings indicate that the incremental cost-effectiveness ratio varies depending on patient population selection, risk factors, and age. For instance, the analysis revealed that proton therapy may be a cost-effective option for younger patients and those with HPV-associated tumours, as it is associated with fewer side effects and reduces the need for long-term care (Bharathi et al. 2023).

The limitations of our study are related to the small number of patients included in the analysis. Further analysis of the cost of PT treatment and the eligible population in the case of the Bulgarian proton centre is needed to assess the affordability of PT.

Conclusions

Most of the patients who receive proton therapy abroad for head and neck cancer are children. Bulgaria has a strategic policy document that focuses on the need and funding possibilities for establishing this treatment within the country. However, the country lacks the political will to ensure appropriate funding for it. Building a national proton centre is a feasible investment but needs additional detailed budget impact analysis.

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Authors contributions

GP and MD drafted the manuscript and performed the policy review of published strategic policy documents for the construction, logistics, and financial coverage of proton therapy in Bulgaria. NT and DP summarised and analysed the real-world data for patients with head and neck cancer in Bulgaria eligible for proton therapy. All authors drafted the discussion and reviewed the final manuscript.

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