

Study of Spatial Unequal Distribution of Infrastructure - Health Services in Greece for Cancer Patients

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Abstract The purpose of this study is to analyze and evaluate the geographical distribution of available services within the National Health System - both public and private - for the diagnosis (primary care) and treatment (secondary care) of oncology patients. The goal is to examine whether there are disparities in infrastructure among the respective Health Regions of Greece, confirming inequalities in the access of cancer patients to effective treatment. The research is based on data from the statistical database of the Ministry of Health, Presidential Decrees on the Operation of Public Hospitals and information from the Hellenic Association of Private Clinics. The study revealed that the majority of available oncology services are concentrated in the larger urban centers of the country, primarily in Athens and Thessaloniki. This reflects the fact that dynamic oncological facilities are mainly located in the regions where medical schools and corresponding university hospitals are based. It is worth noting that the geographical imbalance of available facilities is internationally recognized as a key factor contributing to disparities in access to healthcare services. Finally, the research could in the future be extended to investigate the effectiveness of the health services offered, using the appropriate effectiveness formulas to assess the inputs and outputs of the services.

Keywords Oncology Patients, Anti-cancer Service Structures, Neoplastic Diseases, Cancer Patient Services

1. Introduction

In 2018, more than 5.3 million people lost their lives in EU-28 countries, resulting in an unusually large increase in the number of deaths compared to 2011 [1]. Specifically, the number of deaths in 2018 across all EU countries is predominantly concentrated among individuals aged 65 and older, with more men succumbing to death compared to women in EU countries in 2018. In Greece, 120,363 individuals died in 2018 (compared to 111,099 deaths in 2011), reflecting an 8.34% increase in the number of deaths. It is noteworthy that Greece's population decreased by 3.44% (2011-2018), whereas, as mentioned earlier, the overall population of EU member states increased by 1.89% (2011-2018). Neoplasms (various forms of cancer) accounted for 29.86% of total deaths in Greece in 2018. The annual deaths from neoplasms, on average (2011-2018), represent up to 0.35% of the country's total population.

Addressing neoplasms constitutes a costly process in terms of medical and pharmaceutical care, requiring intensive use of healthcare resources by patients and significant demands for high-end diagnostic and therapeutic technology and research. This, in turn, results in a substantial financial burden on patients and their families, impacting both economic and psychophysical aspects. Consequently, the combination of a life-threatening situation for the patient, coupled with the psychophysical burden on the patient and their relatives, leads to a demand for appropriate care, regardless of geographical and economic obstacles that may exist

between patients and healthcare service providers. Based on the above, the location of appropriate services and the proximity of the patient's residence to the place of treatment are significant parameters in addressing the disease. These factors significantly influence the associated economic and psychophysical costs for cancer patients and their families [2].

The geographical placement of health services, especially specialized health services for treating neoplastic diseases, is a global concern in medical science and healthcare policies. Both developing and developed countries face challenges in the unequal distribution of specialized services, not solely due to deficiencies in infrastructure and other healthcare resources [3]. Often, the large geographical expanse of a country, its fragmentation into individual states/communities, urban/regional centers, and the temporal epidemiological differentiation observed in local societies contribute to changing needs for specialized oncological healthcare services based on the type of neoplasm. The need for the correct distribution of health services is even more critical for preventive (*primary*) medical and diagnostic health services [3],[4],[5]. These services prevent oncological incidents, contribute to their healing, optimize healthcare resource allocation, and map impending deaths from specific neoplasms that have been successfully treated [6],[7].

As mentioned, the issue of uneven distribution of specialized oncology services is not exclusive to Greece but affects other countries as well. In the English health system (*National Health System*), the National Cancer Action Team bases the management of oncological cases on mandatory diagnostic-primary health services that citizens must undergo, preventing oncological incidents. In case of confirmation of oncological cases, guidelines are followed, with a careful approach to patient scheduling [8]. It's worth noting that there is not a particular emphasis on specialized epidemiological studies to transform the health system structures (*creation of new structures, hiring health scientists, etc.*). Instead, the focus is on the efficiency of existing oncology services, given the patients' faithful adherence to procedures to reduce waiting times and eliminate unnecessary patient movements to health service centers.

The United States, characterized by vast expanses and numerous autonomous states, has a private healthcare system. Regarding the management of oncological cases by healthcare facilities, the Association of Community Cancer Centers, through its reports, proposes the creation of new healthcare structures (*flexible, limited structures based on types of neoplasms, e.g., hematologic oncology, chemotherapy units*) based on corresponding epidemiological research, the results of which should be taken into account. Investments in medical research and technology constitute a significant share of the healthcare system's costs, with a focus on developing and investing in oncology service research centers [9].

Furthermore, to reduce disparities in access to healthcare

services, healthcare services are brought to the patient, with the provision of in-home oncology services (*healthcare providers*), constituting a form of secondary healthcare that is encountered and developed in the United States. The privatized healthcare system of the United States operates with an investment-oriented character, considering cost factors significantly. Many innovations and solutions achieved in the specialized field of oncology services are impossible to implement in national systems (*of the Beveridge or Bismarck type*) [10]. Unfortunately, many developing countries lack the basic medical resources and corresponding oncological infrastructure to effectively and equitably address the medical care of all oncology patients [8]. For example, Nigeria (*a country with 186 million inhabitants*) has only seven state oncology hospitals and one private one to care for patients, with no primary preventative medical care available. The ratio of professionals' capacity to healthcare structures is disproportionately low compared to the population's healthcare needs, resulting in numerous access inequalities. Similar situations are observed in other countries such as Botswana, Thailand, and Colombia [6], for which World Health Organization programs plan the reconstruction of their healthcare infrastructure [10],[11].

While European Union countries have historically developed effective oncological infrastructure and expertise, there is a general lack of efficiency and equal distribution of services across member states. The majority of oncological services are concentrated in urban centers. In recent years, EU policies, through the European Cancer Organization (*E.C.O.*), Organization of European Cancer Institutes (*O.E.C.I.*), Comprehensive Cancer Care Networks (*C.C.C.N.*) and the CanCon initiative, aim to advance medical research and technology by developing shared resources/facilities (*biobanks linked to clinical and genetic data, bioinformatics, etc.*) [12]. France, in particular, emphasizes health R&D by investing significant funds. In Germany, the National Cancer Agency, supported by the European Cancer Organization, establishes integrated cancer centers following a three-level care model (*primary, secondary, tertiary*) [13]. The efforts mentioned aim to enhance treatment effectiveness, prevention, and immediate availability of oncological services for all citizens. Italy, following European guidelines, established the Institute Toscano Tumori in Tuscany, providing organized regional structures accessible to all citizens, offering diagnostic and hospital oncological services and conducting cancer research activities [14].

As mentioned above, neoplastic diseases constitute a new "*pandemic*" of modern epidemiology, causing numerous deaths. The global community is not standing idly by and is trying to adapt its health infrastructure in order to deal more effectively with neoplastic diseases and their types [15]. We have mentioned many policies to increase the efficiency and accessibility of oncological services such as epidemiological studies, new

infrastructures, more effective treatment, innovative medical research and technologies, etc.

With regard to Greece, the National Health System has historically been the pillar of the country's health services, facing numerous structural dysfunctions. Many reform efforts have taken place, but they have not been able to reduce the organizational disfunctions that characterize the Health System [16]. The most important problems that characterize the National Health System concern the over-concentration of health structures and services in urban centers (*in Greece there is the phenomenon of "Athenaism" or "Athenization", where a significant part of the population, infrastructure, public management, services and production are concentrated in the Attica region*), limited accessibility of patients to health services and reduced efficiency of the services provided. Some other dysfunctions of the National Health System are inequalities in the receipt of health services, waiting lists and high out-of-pocket payments for accessing and receiving health services from private facilities.

Although Greece's National Health System promotes free and equal access to healthcare, a significant proportion of society finds it difficult to access healthcare due to the long distances to the nearest health services. This multiplies the inequalities of access between the different regions (*urban, semi-urban, rural, etc.*). Waiting lists are a particular malfunction of the National System, as the lower income levels of society are affected as they are unable to choose services from the private sector due to their low income. Patients who wish to receive health services directly and qualitatively by choice pay privately out of their own pockets (*if their financial situation allows it*) in order to have quick accessibility. On the other hand, the vulnerable groups of society and the economically weak, who are in great need of health services, face significant problems in accessing services.

According to the survey by Pierrakos and Tomaras [17], health service recipients express dissatisfaction regarding access, the level of infrastructure and facilities of the health services of the National Health System of Greece. The Vestarides survey [18] which focused on waiting lists in the outpatient clinics of state hospitals compared to evening clinics resulted in waiting lists being longer for health service recipients of day clinics due to the high volume of visitors. The limited options for appointment visit dates have resulted in health service recipients being confused in waiting rooms until their turn comes. Finally, the Kalogeropoulou survey [19], conducted in state hospitals in the Attica region, revealed that only half of the recipients of health services were satisfied with the immediacy of their admission to the hospital, while the majority of respondents were not satisfied with the service, access to health facilities and the building infrastructure that needs improvement.

Based on the above, it is noted that the purpose of the present study is to map, analyze and evaluate the geographical distribution of available services of the

National Health System - public and private, for the diagnosis (*primary care*) and treatment (*secondary care*) of patients with cancer. In this way, it will be examined whether there are discrepancies in infrastructure between the Health Regions of Greece as well as to check whether there is a correlation for access to public or private oncological health services, both at primary and secondary health care levels. Furthermore, it is worth noting that the mapping and analysis of the overall situation in the provision of health services for oncology patients, presented below, are not reflected cumulatively in the official data of the relevant governmental services. In addition, this research could be a trigger for further investigation of the effectiveness of health services provided [20], with the help of a multi-disciplinary team, by collecting primary medical data and health outcomes, while using appropriate effectiveness formulas in order to evaluate public and private health services provided [21].

2. Materials and Methods

In order to investigate the inequalities in infrastructure and accessibility to health services for patients suffering from oncological diseases, it is necessary to investigate the existing situation of services provided throughout Greece, both by the public sector (*Public Hospitals*) and by the private sector (*Private Diagnostic Centers & Private Clinics*). The data used for the study were obtained from the statistical database of the Ministry of Health (*ESYnet*), from the Presidential Decrees of the Operating Organizations of Public Hospitals, as revised and republished in 2021, as well as from the data provided by the Panhellenic Association of Private Clinics [22],[23]. Then the test for the existence of correlation between primary-diagnostic & secondary public and private health services for oncology patients was performed using hypothesis testing by applying the non-parametric X^2 test.

3. Results

3.1. Primary Diagnostic Healthcare Services of the National Health System (NHS) for Cancer Patients

Regarding primary-diagnostic healthcare services provided by the National Health System through Hospitals, we observe that 117 out of 126 operational Public Hospitals (91.27%) offer prevention and diagnosis services for oncological diseases (*Table 1*). These services include radio diagnostics, computed tomography, magnetic resonance imaging, and hematological examinations. The mentioned medical procedures constitute the usual basic diagnostic tests capable of diagnosing the majority of common cancer types (*colon, lung, stomach, and breast*).

Processing the data, based on primarily offered services

and categorizing Public Hospitals per Health Region, we observe significant coverage rates in the four basic diagnostic procedures (*radio diagnostics, computed tomography, magnetic resonance imaging, and blood tests*). Specifically, we observe that all hospitals in the 3rd, 4th, 6th, and 7th Health Regions provide all types of offered services at 100%, followed by the 1st Health Region (98.91%), the 5th Health Region (98.68%), and finally the 2nd Health Region with (93.06%). In conclusion, there is complete coverage of 98.50% for basic diagnostic-primary care services, as shown in Table 2.

3.2. Secondary Services of Public Hospitals for Cancer Patients

At the secondary level, we examined the services provided by public hospitals (*Figures 1a & 1b*) with the aim of addressing (*conservatively or invasively*) cancer through chemotherapy, radiotherapy, or oncological surgery. Analyzing our data (*Table 3*), we observe that 30 out of the 126 operational public hospitals in Greece provide specialized secondary services to oncology patients. This accounts for 23.81% of the Health Units of the National Health System (*NHS*) [24].

Table 1. Total public hospitals providing primary diagnostic oncological healthcare services

No.	Regional Health Authority	Total Number of Hospitals	Number of Public Hospitals with Primary Diagnostic Cancer Services	Percentage
1	1st Regional Health Authority (Attica)	27	22	81.48%
2	2nd Regional Health Authority (Piraeus and Aegean)	20	18	90.00%
3	3rd Regional Health Authority (Macedonia)	16	14	87.50%
4	4th Regional Health Authority (Macedonia and Thrace)	15	14	93.33%
5	5th Regional Health Authority (Thessaly & Central Greece)	13	13	100.00%
6	6th Regional Health Authority (Peloponnese, Ionian Islands, Epirus, and Western Greece)	27	27	100.00%
7	7th Regional Health Authority (Crete)	8	7	87.50%
Total		126	117	91.27%

Table 2. Primary diagnostic oncology health services are provided by all Public Hospitals

Service Coverage	Radio diagnostics	Computed Tomography	Magnetic Resonance Imaging	Blood Tests	Overall Service Coverage
	100%	100%	93.20%	100%	98.50%

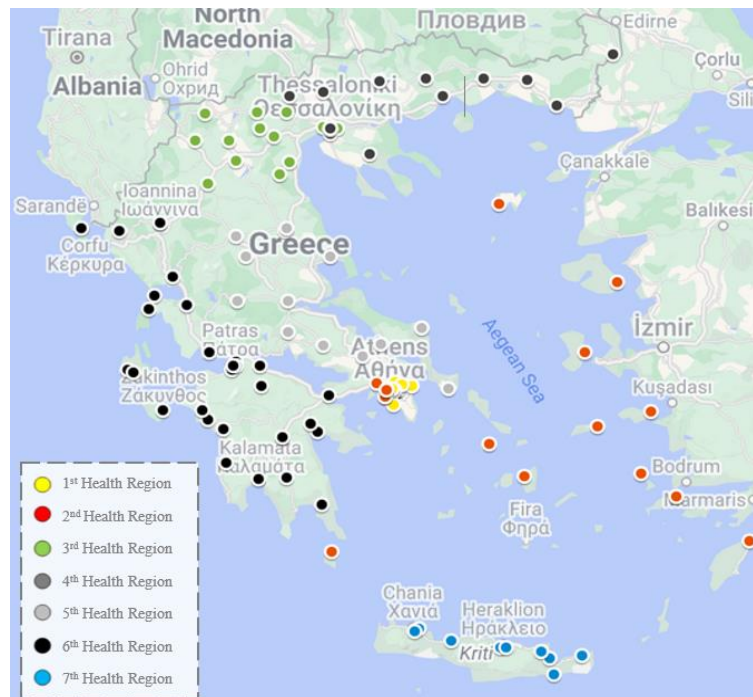


Figure 1a. Total public hospitals per Regional Health Authority

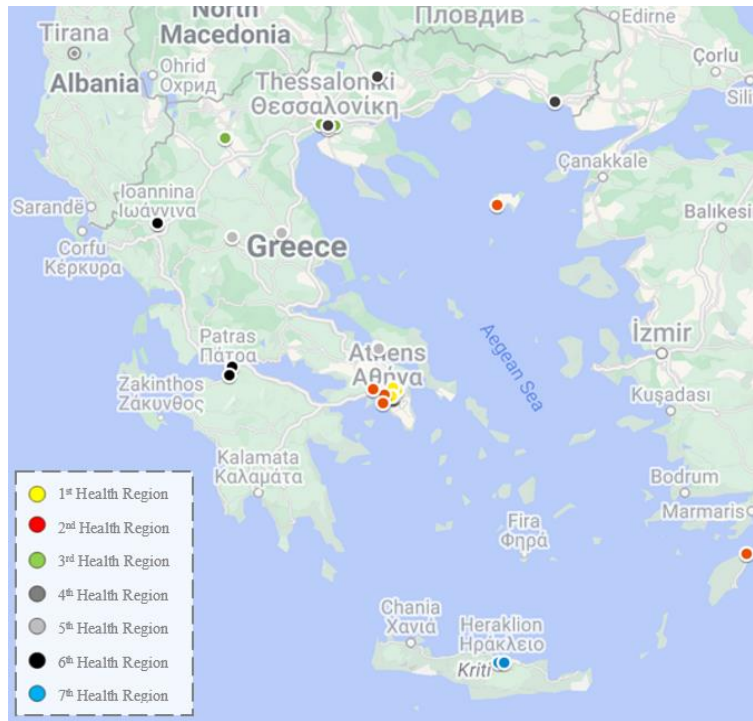


Figure 1b. Total public hospitals per Regional Health Authority with cancer care services

Table 3. Total public hospitals providing secondary cancer care services

No.	Regional Health Authority	Number of Public Hospitals	Secondary Cancer Care Services	Percentage
1	1st Regional Health Authority (Attica)	27	9	33.33%
2	2nd Regional Health Authority (Piraeus and Aegean)	20	5	25.00%
3	3rd Regional Health Authority (Macedonia)	16	3	18.75%
4	4th Regional Health Authority (Macedonia and Thrace)	15	5	33.33%
5	5th Regional Health Authority (Thessaly & Central Greece)	13	3	23.08%
6	6th Regional Health Authority (Peloponnese, Ionian Islands, Epirus, and Western Greece)	27	2	7.41%
7	7th Regional Health Authority (Crete)	8	3	37.50%
Total		126	30	23.81%

Based on our data, the most important specialized cancer hospitals, such as the "Theagenio" Cancer Hospital of Thessaloniki, the "Agios Savvas" General Anticancer Hospital of Athens, the Special Anticancer Hospital "Metaxa" and the University Hospital of Ioannina, manage to collectively provide the majority of healthcare services for cancer patients. Specifically, we have categorized the offered services into Pathological Oncology, Surgical Oncology, Chemotherapy, Radiotherapy, Gynecologic Oncology, Pediatric Oncology, Advanced Imaging Techniques, and Research services. Based on the above categorization, the aforementioned specialized hospitals cover the entire range of services at percentages of 88%, 75%, 63%, and 63% respectively, covering the majority of conservative and interventional methods for treating cancer. Furthermore, they provide research services, such as the "Evgenidio" Foundation of the Anticancer Hospital of Thessaloniki "Theagenio" and the University Oncology Clinic of the National Kapodistrian University of Athens at the General Hospital of Athens "Laiko". Processing the above data, we observe (Table 4) that the majority (60%) of specialized hospitals provide services in Pathological Oncology, Advanced Imaging (50%), Chemotherapy (47%), Radiotherapy (47%), Gynecologic Oncology (20%), Research services (10%), while specialized services in Surgical and Pediatric Oncology are provided only by 7% of the total hospitals, including the following hospitals: "Theagenio" General Anticancer Hospital of Thessaloniki, "Korgialeneio-Benakeio" General Hospital of Athens, "Agia Sofia" Children's Hospital, General Hospital of Agios Nikolaos, respectively. The Attica region has the highest concentration rate of oncology clinics (59.39%) in public hospitals, followed by the Central Macedonia region (29.89%), which includes Thessaloniki. Three regions, mainly rural and island regions, where 18.4% of the total Greek population resides, do not have beds for oncological incidents. In Western Macedonia, the Peloponnese, and the Ionian Islands, no available beds for the hospitalization of oncology patients were recorded (Table 5).

3.3. Private Diagnostic Centers with Primary Cancer Diagnostic Services

In the private healthcare sector, there is an observed

contraction and gradual reduction of approximately 24.7% in the provided primary diagnostic services, as indicated by the official statistics of the Panhellenic Union of Private Clinics (2020). Specifically, from 2018 to the present, a decrease of 24.7% is noted, with 29 private diagnostic centers closing. Regarding the provided diagnostic services (*hematology, magnetic-axial tomography, radio diagnosis, mammography, etc.*) for patients with cancer, either preventive or post-therapeutic, the table below (Table 6) shows that the majority of diagnostic centers (84.07%) offer primary cancer diagnostic services. More precisely, out of the 113 diagnostic centers, 95 provide the primary services categorized above, while the mentioned services are covered by 100% of private diagnostic centers.

A strong presence of large private health groups is observed, established by Regional Health Authorities, offering specialized diagnostic services both preventively and during disease monitoring. The strongest among these are the "Bioiatriki", "Euromedica" and "Iatriki Diagnosi", managing to cover all the studied services through their branch networks. In conclusion (Table 7), it is observed that private diagnostics cover high percentages: Hematological Services (93%), Mammograms (89%), Radiographs (80%), Computed Tomographies (85%) and Magnetic Resonance Imaging (80%).

3.4. Private Clinics Providing Secondary Cancer Services

Private clinics have suffered a significant blow in recent years due to the economic crisis, with approximately 13.7% of them ceasing operations from 2012 until today. Regarding secondary cancer services, we observe that 20.77% of the total private clinics offer such specialized services (Figures 2a & 2b). Specifically, only 38 out of the 183 private clinics provide these services. Significant weaknesses are observed in the 5th, 6th, and 7th Regional Health Authorities (Table 8), where very low coverage percentages of regions are identified (5.41%, 5%, 12.5% respectively). An illustrative example is the 6th Regional Health Authority, where out of 20 private clinics, only the General Clinic "Olympion" provides pathological oncology services.

Table 4. Provided healthcare services by specialized public anticancer hospitals

Coverage of Services	Pathological Oncology	Surgical Oncology	Chemotherapy	Radiotherapy	Gynecologic Oncology	Pediatric Oncology	Advanced Imaging Techniques	Research Services	Overall Coverage of Services
	60%	7%	47%	47%	20%	7%	50%	10%	31%

Table 5. Distribution of beds for cancer patients in Public Hospitals by population and region

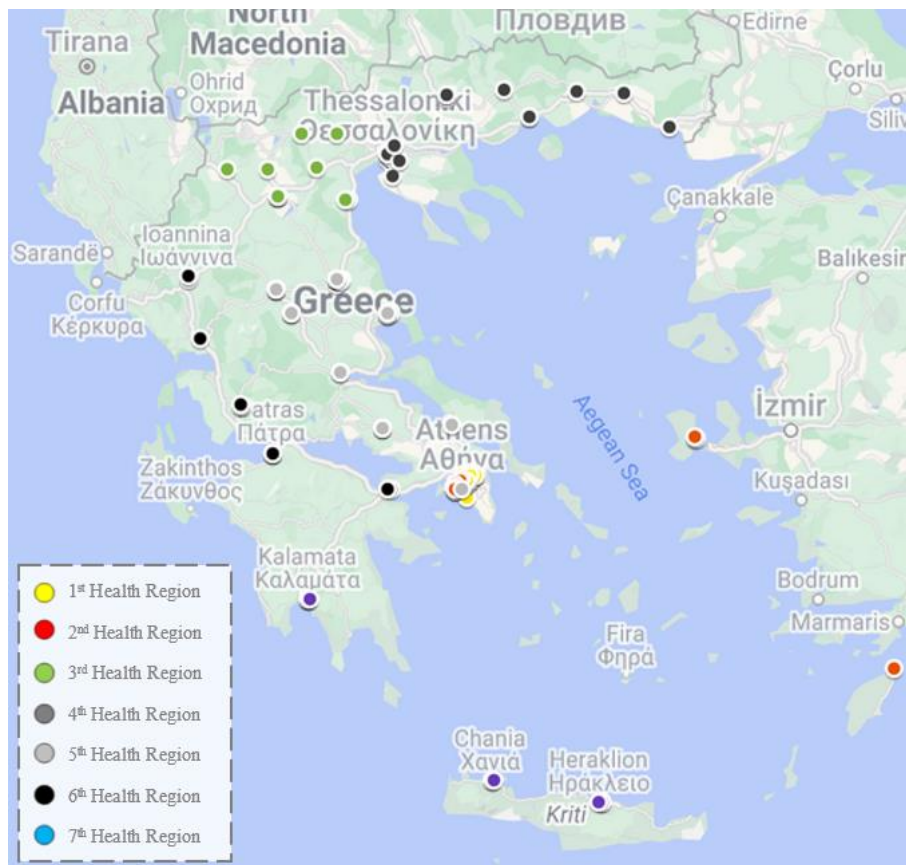
No.	Region	Population 2011	Distribution	Beds per Region	Beds per 100,000 inhabitants	Percentage of Beds to Total
1	Eastern Macedonia and Thrace	608.182	5.62%	50	8.22	1.92%
2	Central Macedonia	1.880.058	17.38%	780	41.49	29.89%
3	Western Macedonia	283.689	2.62%	0	0	0
4	Epirus	336.856	3.11%	30	8.91	1.15%
5	Thessaly	732.762	6.77%	70	9.55	2.68%
6	Ionian Islands	207.855	1.92%	0	0	0
7	Western Greece	679.796	6.28%	10	1.47	0.38%
8	Central Greece	547.390	5.06%	10	1.83	0.38%
9	Attica	3.827.624	35.35%	1.550	40.5	59.39%
10	Peloponnese	577.903	5.34%	0	0	0
11	North Aegean	199.231	1.84%	5	2.51	0.19%
12	South Aegean	308.975	2.85%	5	1.62	0.19%
13	Crete	623.065	5.76%	100	16.05	3.83%
14	Mount Athos (self-governing)	1.811	0.02%	0	0	0
Total		10.815.197	100.00%	2.610	132.14	100.00%

Table 6. Private Diagnostic Centers with Primary Cancer Diagnostic Services per Regional Health Authority

No.	Regional Health Authority	Number of Private Diagnostic Centers	Diagnostic Services	Percentage (%)
1	1st Regional Health Authority (Attica)	64	48	75.00%
2	2nd Regional Health Authority (Piraeus and Aegean)	17	15	88.24%
3	3rd Regional Health Authority (Macedonia)	4	4	100.00%
4	4th Regional Health Authority (Macedonia and Thrace)	8	8	100.00%
5	5th Regional Health Authority (Thessaly & Central Greece)	9	9	100.00%
6	6th Regional Health Authority (Peloponnese, Ionian Islands, Epirus, and Western Greece)	6	6	100.00%
7	7th Regional Health Authority (Crete)	5	5	100.00%
Total:		113	95	84.07%

Table 7. Total private diagnostic centers with Primary Cancer Services in Greece

Coverage of Services	Hematological	Magnetic Resonance Imaging	Computed Tomography	Radiographs	Mammograms	Total Coverage of Services
	93%	80%	85%	86%	89%	88%

**Figure 2a.** Private Clinics by Regional Health Authority

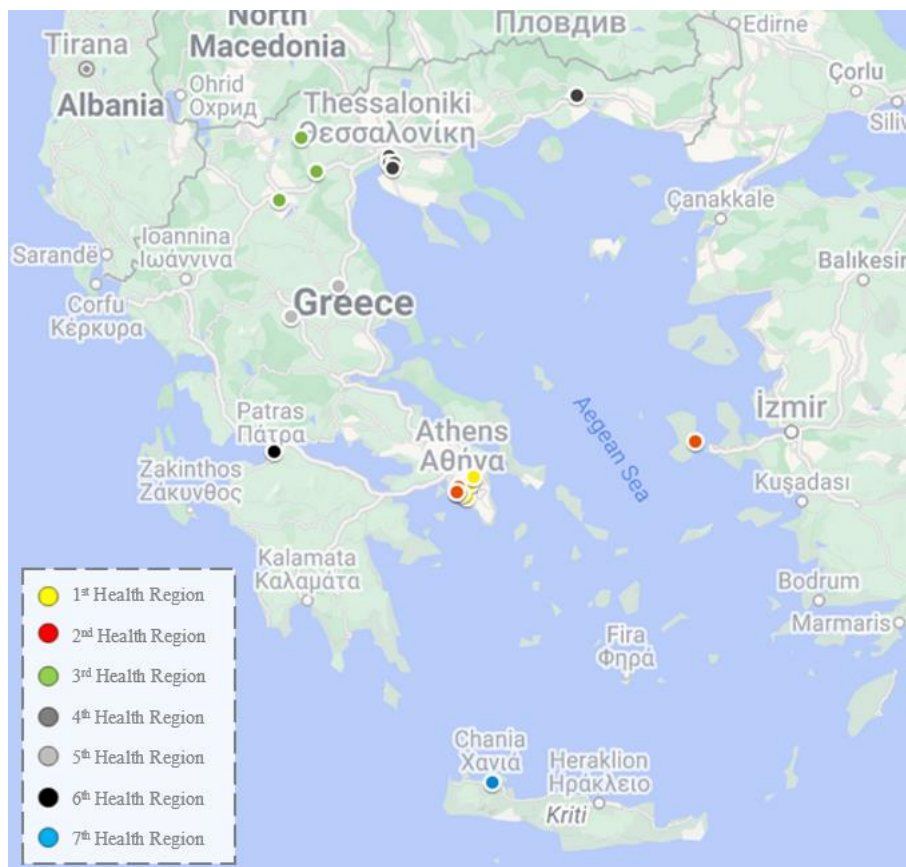


Figure 2b. Private Clinics by Regional Health Authority with Cancer Services

Table 8. Total private diagnostic centers with Primary Cancer Services in Greece

No.	Regional Health Authority	Number of Private Clinics	Cancer Diagnostic Services	Percentage %
1	1st Regional Health Authority (Attica)	56	18	32.14%
2	2nd Regional Health Authority (Piraeus and Aegean)	23	6	26.09%
3	3rd Regional Health Authority (Macedonia)	12	3	25.00%
4	4th Regional Health Authority (Macedonia and Thrace)	27	7	25.93%
5	5th Regional Health Authority (Thessaly & Central Greece)	37	2	5.41%
6	6th Regional Health Authority (Peloponnese, Ionian Islands, Epirus, and Western Greece)	20	1	5.00%
7	7th Regional Health Authority (Crete)	8	1	12.50%
Total:		183	38	20.77%

Categorizing the basic cancer services (pathological oncology, surgical oncology, radiotherapy, chemotherapy, pediatric oncology, gynecological oncology, specialized services) by Regional Health Authority, we rank private clinics (based on coverage percentages) as follows: 1st (37.30%), 4th (36.73%), 5th (35.72%), 3rd (23.81%), 2nd (23.80%), 6th (28.57%) and 7th (14.28%). Significant coverage is concentrated in private clinics located in the 1st and 4th Regional Health Authorities, i.e., in the regions with the largest urban centers in Greece.

Additionally, we observe that specific private clinics of healthcare groups manage to provide all categories of services, such as the “Iatriko Diavalkaniko”, “General Clinic”, “Metropolitan Therapeutic - Metropolitan Hospital”, “Iaso” etc. There is significant coverage in oncology services (97.16%), as well as satisfactory coverage in specialized oncology services (39.79%), for Greek standards. Chemotherapy-radiotherapy and Breast Clinics are close to 20%, while pediatric oncology services from private clinics are almost non-existent

(Table 9).

Analyzing the results obtained from the above study, we observe a significant imbalance in the distribution of available resources and services. In conclusion, as revealed, the pattern of over-concentration applies to the entire spectrum of provided services for the care of oncology patients at the secondary level. As seen from the results, there is a concentration of resources in the regions of major urban centers (*Attica, Central Macedonia, Crete, and Thessaly*). Specifically, 9 out of 27 hospitals in Attica provide oncology patient care services. Additionally, 3 out of 4 cancer hospitals in Greece are located in Attica, with the only pediatric oncology hospital located in Athens.

Regarding the distribution of oncology patient care beds, we observe that 59.39% of beds (*1.550 beds*) are located in hospitals in the Attica region, available to 35.35% (*3.827.624 residents*) of the total population of Greece. Furthermore, 18 out of 38 private clinics providing cancer services operate in the Attica region, specifically in Athens and Piraeus. These clinic units belong to private health groups that are reinforced with bed capacity and service provision. Additionally, it is observed that oncology structures are mainly found in regions where university hospitals with corresponding oncology clinics operate. This observation reflects the regional structure of the country's healthcare system with a focus on university schools. In the table below (*Table 10*), the situation prevailing in primary-diagnostic healthcare structures for oncology patients is depicted, categorized by the type of

provided service (*Radio diagnostic, CT/MRI, Hematology*).

The total number of diagnostic service types is concentrated in the 1st Health Region (*Attica*) and the 2nd Health Region (*Piraeus*) with 91 and 67 types of primary structures for cancer services, respectively. In the 3rd and 4th Health Regions of Central Macedonia and Thrace, 56 types of primary health structures for cancer patients are distributed. In summary, 70% of the total types of public health structures are concentrated in Attica, Macedonia, and Thrace, while only 32 types of structures (*8 Radio diagnostics, 8 CTs, 8 MRIs, 8 Hematology*) are observed in the Health Region of Crete. Finally, a total of 460 services are provided by public hospitals nationwide based on their distribution into the 4 categories mentioned, while, as we will see below, private diagnostic centers provide only 285 services nationwide (*62% fewer services than public hospitals*).

Regarding private diagnostic centers, in the above Table 11, we observe that they are mainly concentrated in Attica (*1st RHA*). Private health groups seem to invest economically and operationally in the health sector of Attica, providing 153 services, while limiting their business activities in Macedonia and Thrace, with only 29 total services (*radio diagnostics, computed tomography/magnetic resonance imaging, hematology, mammography*) in Northern Greece. Furthermore, in the rest of Greece (*5th, 6th, 7th RHA*), there are only 58 private diagnostic services for the total types of primary services.

Table 9. Total Offered Secondary Cancer Services by Private Clinics

Coverage of Services	Pathological Oncology	Surgical Oncology	Radiotherapy	Chemotherapy	Pediatric Oncology	Gynecological Oncology – Breast Clinic	Specialized Oncology Services	Total Service Coverage
	97.16%	19.50%	15.98%	23.13%	0.79%	22.11%	39.79%	31,21%

Table 10. Total Primary-Diagnostic Services of Public Hospitals for Cancer Patients, by Regional Health Authority

Regional Health Authority	Radio diagnostics	Computed Tomography	Magnetic Resonance Imaging	Hematology	Total
1st Health Region (Attica)	23	23	22	23	91
2nd Health Region (Piraeus and Aegean)	18	18	13	18	67
3rd Health Region (Macedonia)	14	14	14	14	56
4th Health Region (Macedonia and Thrace)	14	14	14	14	56
5th Health Region (Thessaly & Sterea Ellada)	13	13	12	13	51
6th Health Region (Peloponnese, Ionian Islands, Epirus, and Western Greece)	27	27	26	27	107
7th Health Region (Crete)	8	8	8	8	32
Total:	117	117	109	117	460

Table 11. Total private diagnostic centers with primary-diagnostic services for cancer patients, by Regional Health Authority

Regional Health Authority	Radio diagnostics	Computed Tomography	Magnetic Resonance Imaging	Hematology	Total
1st Health Region (Attica)	36	37	36	44	153
2nd Health Region (Piraeus and Aegean)	14	8	8	15	45
3rd Health Region (Macedonia)	2	3	2	2	9
4th Health Region (Macedonia and Thrace)	5	5	5	5	20
5th Health Region (Thessaly & Central Greece)	5	5	5	7	22
6th Health Region (Peloponnese, Ionian Islands, Epirus, and Western Greece)	5	5	5	5	20
7th Health Region (Crete)	4	4	4	4	16
Total	71	67	65	82	285

Table 12 below depicts the situation in secondary hospital health structures for cancer patients, categorized by the type of provided services (*pathological oncology, surgical oncology, chemotherapy, radiotherapy, gynecological oncology, pediatric oncology*). The total number of types of secondary health services is concentrated in the 1st, 2nd, 3rd, and 4th Health Regions (*1st, 2nd, 3rd, and 4th Regional Health Authority*), amounting to 39 types of secondary oncological services out of a total of 56 types of structures across all Health Regions. Meanwhile, a total of 17 types of public secondary health services are distributed in the rest of Greece.

In contrast to private diagnostic centers, Table 13 reveals that the total services provided by private clinics for cancer patients (57) surpass those of public hospitals (84). The overwhelming majority of these services are concentrated in the 1st and 2nd Health Regions (*Attica and Piraeus*). The 16 types of hospital oncological services are offered in the 4th Health Region (*Macedonia*), specifically in the city of Thessaloniki. Meanwhile, only 7 types of private oncological services (*remaining*) are distributed in the rest of Greece, reflecting the investment policies of the private healthcare sector, leaving the rest of Greece (*Thessaly, Central Greece, Peloponnese, Epirus, Western Greece, Ionian Islands, and Crete*) almost "uncovered."

For the examination of the correlation between primary diagnostic public and private health services for oncology patients, the non-parametric Chi-Square test was applied

to the relevant variables. The application yielded the following p-value "Asymptotic Significance (2-sided)" values (Table 14): For radio diagnostic services 0.273, for CT and MRI scans 0.273, for hematological services 0.243 and for the overall mentioned services of the public and private sectors, the p-value is 0.243. From these results, it is evident that there is no correlation between the types of diagnostic primary services (*Radio diagnosis, CT/MRI, Hematology*) in the public and private sectors.

Applying the same test to examine the correlation between secondary-hospital public and private health services for cancer patients, it was checked whether there is an association between the types of secondary-hospital services (*pathological oncology, surgical oncology, chemotherapy, radiotherapy, gynecological oncology, pediatric oncology*) in the public and private sectors. From the results of the Chi-Square test, as reflected in the results of Table 15, the following p-value "Asymptotic Significance (2-sided)" values are obtained: For pathological oncology services 0.113, surgical oncology 0.190, chemotherapy 0.050, radiotherapy 0.321, gynecological oncology 0.247, pediatric oncology 0.088, and for the total of the aforementioned public and private sector services, p-value=0.243. From these results, it is concluded that there is no correlation between the types of secondary-hospital services (*pathological oncology, surgical oncology, chemotherapy, radiotherapy, gynecological oncology, pediatric oncology*) in the public and private sectors.

Table 12. Total public hospitals providing secondary cancer care services

Regional Health Authority	Pathological Oncology	Surgical Oncology	Chemotherapy	Radiotherapy	Gynecologic Oncology	Pediatric Oncology	Overall Coverage of Services
1st Health Region (Attica)	5	1	4	3	2	1	16
2nd Health Region (Piraeus and Aegean)	3	0	1	3	1	0	8
3rd Health Region (Macedonia)	1	0	2	1	0	0	4
4th Health Region (Macedonia and Thrace)	3	1	3	3	1	0	11
5th Health Region (Thessaly & Central Greece)	2	0	0	1	0	0	3
6th Health Region (Peloponnese, Ionian Islands, Epirus, and Western Greece)	1	0	2	2	1	0	6
7th Health Region (Crete)	3	0	2	1	1	1	8
Total	18	2	14	14	6	2	56

Table 13. Private clinics providing secondary health services for cancer patients, by Health Region

Regional Health Authority	Pathological Oncology	Surgical Oncology	Chemotherapy	Radiotherapy	Gynecological Oncology	Pediatric Oncology	Total
1st Health Region (Attica)	17	4	11	11	3	1	47
2nd Health Region (Piraeus and Aegean)	6	1	1	1	1	0	10
3rd Health Region (Macedonia)	3	1	0	0	0	0	4
4th Health Region (Macedonia and Thrace)	6	1	2	2	5	0	16
5th Health Region (Thessaly & Central Greece)	2	1	1	0	1	0	5
6th Health Region (Peloponnese, Ionian Islands, Epirus, and Western Greece)	1	0	0	0	0	0	1
7th Health Region (Crete)	1	0	0	0	0	0	1
Total	36	8	15	14	10	1	84

Table 14. Total Primary-Diagnostic Health Services for Cancer Patients, by Regional Health Authority (Public and Private)

Radiological Diagnostic			Axial Tomography			Magnetic Resonance		
Chi-Square Tests			Chi-Square Tests			Chi-Square Tests		
	Value	Asymptotic Significance (2-sided)		Value	Asymptotic Significance (2-sided)		Value	Asymptotic Significance (2-sided)
Pearson Chi-Square	23,333^a	0,273	Pearson Chi-Square	23,333^a	0,273	Pearson Chi-Square	23,333^a	0,273
Likelihood Ratio	17,878	0,595	Likelihood Ratio	17,878	0,595	Likelihood Ratio	17,878	0,595
Linear-by-Linear Association	1,372	0,241	Linear-by-Linear Association	1,285	0,257	Linear-by-Linear Association	1,264	0,261
N of Valid Cases	7		N of Valid Cases	7		N of Valid Cases	7	
a. 30 cells (100,0%) have an expected count of less than 5. The minimum expected count is 14.			a. 30 cells (100,0%) have an expected count of less than 5. The minimum expected count is 14.			a. 30 cells (100,0%) have an expected count of less than 5. The minimum expected count is 14.		
Hematological			Total					
	Value	Asymptotic Significance (2-sided)		Value	Asymptotic Significance (2-sided)			
Pearson Chi-Square	29,750 ^a	0,234	Pearson Chi-Square	29,750 ^a	0,234			
Likelihood Ratio	21,698	0,653	Likelihood Ratio	21,698	0,653			
Linear-by-Linear Association	1,293	0,255	Linear-by-Linear Association	1,3	0,254			
N of Valid Cases	7		N of Valid Cases	7				
a. 36 cells (100,0%) have an expected count of less than 5. The minimum expected count is 14.			a. 36 cells (100,0%) have an expected count of less than 5. The minimum expected count is 14.					

Table 15. Total Secondary Health Services for Cancer Patients, by Regional Health Authority (Public and Private)

Pathological Oncology			Surgical Oncology			Chemotherapy		
Chi-SquareTests			Chi-SquareTests			Chi-SquareTests		
	Value	Asymptotic Significance (2-sided)		Value	Asymptotic Significance (2-sided)		Value	Asymptotic Significance (2-sided)
Pearson Chi-Square	18,083^a	0,113	Pearson Chi-Square	3,325^a	0,19	Pearson Chi-Square	21,000^a	0,05
Likelihood Ratio	15,106	0,236	Likelihood Ratio	3,877	0,144	Likelihood Ratio	17,878	0,119
Linear-by-Linear Association	4,172	0,041	Linear-by-Linear Association	2,85	0,091	Linear-by-Linear Association	2,789	0,095
N of Valid Cases	7		N of Valid Cases	7		N of Valid Cases	7	
a. 20 cells (100,0%) have an expected count of less than 5. The minimum expected count is 14.			a. 6 cells (100,0%) have an expected count of less than 5. The minimum expected count is 29.			a. 20 cells (100,0%) have an expected count of less than 5. The minimum expected count is 14.		
Radiotherapy			Gynecological Oncology			Pediatric Oncology		
Chi-SquareTests			Chi-SquareTests			Chi-SquareTests		
	Value	Asymptotic Significance (2-sided)		Value	Asymptotic Significance (2-sided)		Value	Asymptotic Significance (2-sided)
Pearson Chi-Square	7,000^a	0,321	Pearson Chi-Square	7,875^a	0,247	Pearson Chi-Square	2,917^a	0,088
Likelihood Ratio	9,561	0,144	Likelihood Ratio	6,788	0,341	Continuity Correction ^b	0,263	0,608
Linear-by-Linear Association	2	0,157	Linear-by-Linear Association	1,137	0,286	Likelihood Ratio	2,969	0,085
N of Valid Cases	7		N of Valid Cases	7		N of Valid Cases	7	
a. 12 cells (100,0%) have an expected count of less than 5. The minimum expected count is 14.			a. 12 cells (100,0%) have an expected count of less than 5. The minimum expected count is 14.			a. 4 cells (100,0%) have an expected count of less than 5. The minimum expected count is 29. b. Computed only for a 2x2 table.		
Total								
Chi-SquareTests								
	Value	Asymptotic Significance (2-sided)						
Pearson Chi-Square	35,000^a	0,243						
Likelihood Ratio	24,47	0,75						
Linear-by-Linear Association	0,2	0,655						
N of Valid Cases	7							
a. 42 cells (100,0%) have an expected count of less than 5. The minimum expected count is 14.								

4. Conclusions

As described above, neoplastic disease is a new "pandemic" all over the world [25],[26]. In Greece, deaths from oncological diseases are increasing at a rate greater than the rate at which the population is declining, creating a bleak demographic and epidemiological outlook. The above study analyzed and evaluated the geographical distribution of the available structures and services of the Greek Health System (*public and private*), both for the diagnosis (*primary care*) and treatment (*secondary care*) of oncology patients. For the survey, data from the statistical database of the Ministry of Health, the Operating Organizations of Public Hospitals as well as data from the Panhellenic Association of Private Clinics were used. The survey showed that the structures providing primary oncology services and the completeness of the types of services provided are satisfactory, particularly for public health facilities. On the contrary, the structures providing secondary oncology services are much fewer than the total structures providing health services, especially for private health facilities, while pediatric oncology and gynecological oncology services are scarce, both for public and private health facilities. In addition, it emerged that the distribution of the majority of oncology structures and services offered is based in the largest urban centers of the country (*mainly in Athens, Piraeus and Thessaloniki*), reflecting discrepancies in infrastructure and health services offered (*mainly secondary oncology services*) between the health Regions of the country (*both in public hospitals and private clinics*), verifying the inequalities in access to treatment for cancer patients.

The over-concentration of oncological structures in urban centers (*Attica and Macedonia*) and the limited types of oncological services provided per health region, increase the cost and time of receiving health services for oncological patients, inconveniencing them and their companions with frequent travel and additional out-of-pocket payment costs. The concentration of thirteen hospitals in an area of less than one square kilometer in the center of Athens negates any notion of a rational distribution of hospital beds to meet the needs of the population and consequently causes access difficulties for the majority of patients, reflecting a manifestation of the *Athens centralized* phenomenon as mentioned in the introduction. In addition, the proximity of the hospitals places a traffic burden on one of the most important roads in the city, while their operation contributes significantly to air pollution and the overheating of the city center. Furthermore, the data processing showed that there is no correlation between private and public oncology services, demonstrating their independence as the choice of a public structure does not influence the choice of a private structure. Patients with a similar financial situation spend money on private oncology services in order to receive health services more directly and do not use public health

structures, as the reverse is also true. This means that vulnerable and economically weaker citizens will find it difficult to have direct access to inexpensive oncological health services.

An important problem for Greece is the lack of epidemiological data, which makes it particularly difficult to carry out therapeutic studies. Furthermore, the lack of time-series statistics on the incidence of individual oncological diseases and patients, the under-functioning of the National Neoplasia Archive, the inadequate National Plan against Cancer, the speculative ambitions of private health care investments, the lack of national biotechnology and medical technology research and development of treatment protocols, the lack of national biotechnology and medical technology research and development organizations, and the lack of modernization of and investment in the National Health System, make the situation particularly difficult to establish an effective national plan for the equal distribution of services for oncology patients and the limitation.

Of course, the above problems are not a monopoly of our country. They are found in many other developed countries (*European countries, Australia, India, Scandinavian countries*), which, on the basis of national strategic health policies, have undertaken reforms and additional measures to mitigate inequalities in oncology services. Some of these measures (*included in the European cancer strategies*) [9],[15] include demographically-based epidemiological studies, preventive medicine, investment in oncology technologies, more effective chemotherapy/radiation treatment protocols, more flexible oncology treatment structures, involvement of organizations and institutions (*universities, research institutions*) in treatments and health service delivery [12], while similar cancer organizations in the system are also involved in the provision of health services [6],[27].

Unfortunately, some concepts of the above actions and policies are completely unknown in Greece and have not been tested by the actors of the Health System. As mentioned, the allocation of health resources based on population and epidemiological needs is considered necessary, while "smart", effective and innovative solutions could be provided by investing in biotechnology services, e-health, medical technology and more efficient treatment protocols for neoplastic diseases, making health services more efficient. Finally, the present research could be a trigger for further investigation of the efficiency of the health services offered, by creating a multi-disciplinary research team (*medical scientists, epidemiologists, statisticians etc.*) by collecting primary medical data & health outcomes and using the appropriate types of efficiency (*such as Productive efficiency, Technical efficiency, Allocative Efficiency*) [20] can evaluate the health services provided, while proposing to maximize outputs or minimize inputs for a given level of outputs, which can be interpreted into indicators of epidemiological health outcomes e.g. QALY's – quality weighted life years,

life expectancy, infant mortality, life expectancy at birth, etc.

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