MedLife Clinics

ISSN: 2689-5943

Research Article

An Analysis of the Distribution of Cancer Centers in Brazil

Guilherme Querido de Queiroz Ferreira Borrelli, Juliana Vieira Biason Bonometto, Daniel Gomes de Iracema Cubero and Auro del Giglio*

Centro Universitário Faculdade de Medicina do ABC (FMABC), Brazil

Abstract

Background: The diagnosis and treatment of cancer is complex and necessitate quaternary centers, which require technology and investment. To better serve the population, such centers should be distributed equitably among the states and according to demand. Even with public policy favoring an increase in the number of oncology centers in Brazil, it is necessary to verify the distribution of these centers, as they have a key role in the population's access to cancer treatment. However, there are few studies evaluating this distribution in the literature.

Objective: To verify whether the distribution of the oncology network in Brazil meets the needs of each state.

Method: This is a descriptive study with data from official federal sources made available by the National Cancer Institute (Instituto Nacional do Cancer-INCA), Department of Informatics of the SUS, Ministry of Health, National Commission of Nuclear Energy (CNEN) and the Brazilian Institute of Geography and Statistics (IBGE). New cancer cases projected for 2020 were compared with data on the number and distribution of radiotherapy centers and highly complex oncology centers (CACON/UNACON) in each state. The Municipal Human Development Index (MHDI) was used to estimate the population's access to health care in the states, along with Gross Domestic Product (GDP), which was used to calculate the wealth of each state.

Results: In 2020, there were 386 CACON/UNACONs and 267 radiotherapy centers in Brazil, and 65.5% of the CACON/UNACONs and 66.7% of the radiotherapy centers were concentrated in five states (SP, RJ, MG, PR, RS). Of the cancer cases projected for 2020, 59.6% are concentrated in these five states. Among the states with lower GDP and lower education, there are three with a high number of anticipated cases for each CACON/UNACON (PB, SE and PI) and three with a high number of such cases for radiotherapy centers in PI, PB, RN); RR and AP do not have radiotherapy centers.

Conclusion: It can be concluded that the distribution of oncology centers is not equitable among the states because among the poorest states, there is a smaller number of centers for a greater number of cases.

Keywords: Distribution; Network; Oncology; Brazil; CACON; UNACON; Centers

Introduction

Cancer is the second leading cause of death worldwide, and approximately 70% of cancer cases occur in low-and middle-income countries, such as Brazil [1]. The National Cancer Institute projects that Brazil presented approximately 625,370 new cases of cancer in 2020 [2] and that there will be 21.4 million new cases worldwide in 2030 [3], showing that cancer is a disease of high incidence. According to Oliveira et al. [4], the gradual increase in cancer incidence and mortality is due to demographic growth, population aging and socioeconomic development. In addition to the public health challenge that this trend presents to Brazil's medical system, ensuring full access to health care for patients across the country 15 requires a balance between supply and demand to offer convenient and complete diagnosis and treatment services in every state.

The State, according to the Constitution of 1988, has the duty to guarantee the right of every citizen to health. For this purpose, the SUS has Quaternary oncology centers: High Complexity in Oncology (CACON) and High Complexity Oncology Care Unit (UNACON). CACON is a center that offers specialized and comprehensive care to cancer patients. It acts in the area of prevention, early detection, diagnosis and treatment [5]. It should cover seven modalities of patient care: diagnosis, cancer surgery, clinical oncology, radiotherapy, support measures, rehabilitation and palliative care [5]. UNACON, in turn, is a hospital unit with technical conditions, physical facilities, equipment and human resources appropriate to the provision of highly complex specialized care for the definitive diagnosis and treatment of the most prevalent cancers [6].

The cancer treatment centers should be equally distributed among the states, according to population demands, ensuring equitable access to cancer treatment. This distribution should consider the identification of the poles of attraction, the regionalization of care, the distances traveled by the population in the search for care, and the numbers involved in these displacements [4].

With the objective of increasing the quality and access to cancer treatment, policies for cancer control were implemented in Brazil, such as Oncology Assistance Expansion Project (EXPANDE 2000) in 2000, the National Policy for Cancer Care in 2005 and the National Policy for Cancer Prevention and Control in Brazil 2013. EXPANDE 2000 aims to expand access to cancer treatment in Brazil, considering the challenge of reducing regional inequalities in the provision of cancer care to the Brazilian population in the SUS [7]. In 2005, the National Policy for Oncological Care established hierarchical networks for oncological care [8]. One of the principles of the National Cancer Prevention and Control Policy in 2013 was the organization

Citation: de Queiroz Ferreira Borrelli GQ, Biason Bonometto JV, de Iracema Cubero DG, del Giglio A. An Analysis of the Distribution of Cancer Centers in Brazil. Med Life Clin. 2023; 5(1): 1048.

Publisher Name: Medtext Publications LLC

Manuscript compiled: Jun 14th, 2023

***Corresponding author:** Guilherme Querido de Queiroz Ferreira Borrelli, Centro Universitário Faculdade de Medicina do ABC (FMABC), Brazil

of regionalized and decentralized care networks with respect to access criteria, scale and scope [9]. Together, these policies generated an increase of 71.3% in the number of health facilities authorized for cancer treatment from 2003 to 2018 [10].

Despite the implementation of these policies and a 71.3% increase in the number of oncology establishments, a considerable number of patients must travel to other areas to gain access to oncology centers, as evidenced in the study Migration [11]. From 2000 to 2015, the number of cancer deaths in Brazil increased by 73.31% [12]. A good distribution of quaternary services among the states is imperative so that more people have access to early diagnosis and treatment, thus increasing the chances of cure and reducing mortality.

Studies evaluating the distribution of these resources throughout the country are scarce. Thus, this study aims to verify whether the distribution of the oncology network in Brazil is in accordance with the needs of each region.

Objective

To verify whether the distribution of the oncology network in Brazil is in accordance with the needs of each state.

Method

This is a descriptive study with data from official federal sources made available by the National Cancer Institute (Instituto Nacional do Cancer-INCA), the Department of Informatics of the SUS (SIH), the Ministry of Health, the National Nuclear Energy Commission and the Brazilian National Institute of Geography and Statistics (IBGE). Data from the projection of new cases of cancer for 2020 were compared with the number of radiotherapy centers and centers of high complexity in oncology (CACON/UNACON) per state.

The MHDI was used as an indicator of education, and the Gross Domestic Product (GDP) was used to estimate the wealth of each state. The number of hospitalizations outside the state of origin was calculated by subtracting the number of hospitalizations per place of residence of a state by the number of hospitalizations per place of hospitalization in the same state. States that obtained a positive result of hospitalizations outside the state of origin were considered recipients, i.e., those who received a significant number of cancer patients from other states.

The projected ratio of new cancer cases per radiotherapy center together with the projected ratio of new cancer cases by CACON/UNACON was used to verify whether there is a balance between the demand of cancer patients and the supply of cancer treatment centers in each state.

Using the Spearman correlation test and STATA software, the following evaluations were performed:

- Correlation between projected new cases of cancer by state and number of CACONs/UNACONs per state.
- Correlation between projected new cases of cancer by state and number of radiotherapy centers per state.
- Correlation between GDP per state in thousands and number of CACONS/UNACONs per state.
- Correlation between GDP per state in thousands and number of radiotherapy centers per state.
- Correlation between GDP per state in thousands and projection of new cases per state.
- Correlation between averages HDI based on education in 2017 and GDP per capita per state in thousands.
- Correlation between population per state and number of CACONs/UNACONs per state.
- Correlation between population by state and number of radiotherapy centers by state.

Results

In 2020, Brazil had 386 high-complexity centers and 267 radiotherapy centers, with 253 (65.5%) of the high-complexity centers and 178 (66.7%) of the radiotherapy centers concentrated in five states (SP, RJ, MG, PR, RS) and 372,510 (59.6%) of the 625,370 new cases projected for 2020, as shown in Table 1. These states are the 1st, 3rd, 2nd, 5th and 6th largest populations in Brazil and the 1st, 2nd, 3rd, 5th and 4th with the highest GDP.

Table 2 shows that the states with the lowest GDP include Roraima, Acre and Amapá, and the lowest HDIs based on education are Alagoas, Sergipe and Bahia. The states with the highest number of new cases projected for each high complexity oncology center were Goiás, Ceará and the Federal District. The states that had a high number of projected new cases for each radiotherapy center were Rio Grande do Norte, Ceará and Goiás. Roraima and Amapá did not have radiotherapy centers.

There were seven states that were considered recipients: RO, ES, PR, PE, PI, RN, and SP (1 in the north region; 2 southeast; 1 south; 3 northeast), as they had a greater number of hospitalizations than their populations indicated, showing that they were receiving patients from other places. There were no recipient states in the midwest region.

According to Graphs 1 and 2, there is a strong relationship between the projected number of new cancer cases for each state and the number of high complexity centers in oncology (Spearman's $\rho = 0.9686$ $p<0.001$) and radiotherapy centers per state (Spearman's $\rho = 0.9841$ $p<0.001$).

Graphs 3, 4 and 5 indicate that there is a direct and positive relationship between GDP per state and the number of CACONs and UNACONs per state (Spearman's $\rho = 0.9356$ $p<0.001$), number of radiotherapy centers per state (Spearman's $\rho = 0.9742$ $p<0.001$) and projection of new cases of cancer by state (Spearman's $\rho = 0.9760$ $p<0.001$), respectively.

Graph 6 shows that the states with the highest GDP per capita tend to have a higher average HDI based on education (Spearman's $\rho = 0.8606$ $p<0.00001$).

Graph 7 and 8 shows that the states with the largest populations tend to have a greater number of CACONs/UNACONs (Spearman's $\rho = 0.9406$ $p<0.001$) and radiotherapy centers (Spearman's $\rho = 0.9626$ $p<0.001$).

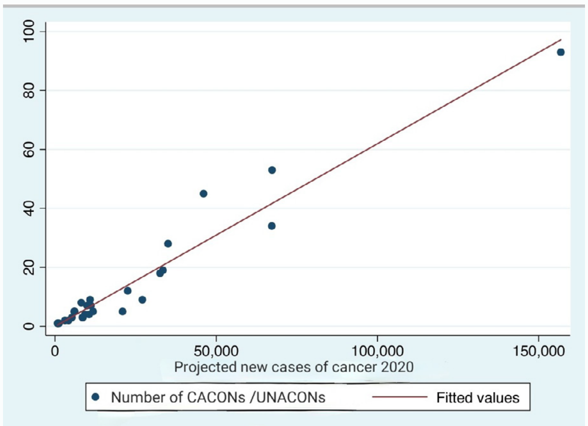
Discussion

This study made it possible to verify the distribution of cancer treatment centers in each state according to the projected number of cases for 2020, GDP, GDP per capita, and HDI.

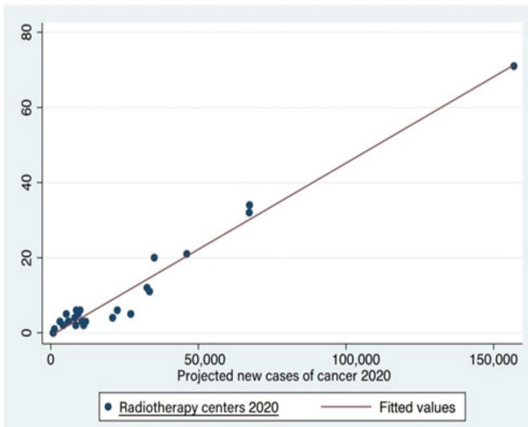
As shown in the results, the distribution of cancer treatment centers could be considered equitable, since the number of cancer treatment centers increases as the projected number of new cancer cases per state, population and GDP grow, with the exception of states

Table 1: Frequency distribution of radiotherapy centers, CACONs/UNACONs, projection of new cases and population, by Brazilian states in 2020.

State/Region	Radiotherapy centers		CACONs/UNCAONs		Projection of new cases		Population
	n	%	n	%	n	%	N
Southeast	**140**	**52%**	**189**	**49%**	**302,280**	**48%**	**89.012.240**
São Paulo	71	27%	93	24%	156,870	25%	46.289.333
Rio de Janeiro	32	12%	34	9%	67,220	11%	17.366.189
Espírito Santo	3	1%	9	2%	10,880	2%	4.064.052
Minas Gerais	34	13%	53	14%	67,310	11%	21.292.666
South	**52**	**19%**	**92**	**24%**	**114,570**	**18%**	**30.192.315**
Santa Catarina	11	4%	19	5%	33,460	5%	7.252.502
Paraná	20	7%	28	7%	35,050	6%	11.516.840
Rio Grande do Sul	21	8%	45	12%	46,060	7%	11.422.973
North	**16**	**6%**	**14**	**4%**	**24,670**	**4%**	**18.672.591**
Amapá	0	0%	1	0%	860	0%	861.773
Tocantins	2	1%	2	1%	4,200	1%	1.590.248
Rondônia	3	1%	2	1%	3,090	0%	1.796.460
Amazon	5	2%	3	1%	5,250	1%	4.20.714
Acre	1	0%	1	0%	1,240	0%	894.47
Roraima	0	0%	1	0%	780	0%	631.181
Pará	5	2%	4	1%	9,250	1%	8.690.745
Northeast	**39**	**15%**	**68**	**18%**	**136,210**	**22%**	**57.374.243**
Ceará	5	2%	9	2%	27,080	4%	9.187.103
Rio Grande do Norte	2	1%	7	2%	11,140	2%	3.534.165
Pernambuco	6	2%	12	3%	22,530	4%	9.616.621
Maranhão	3	1%	4	1%	10,560	2%	7.114.598
Sergipe	3	1%	5	1%	5,950	1%	2.318.822
Bahia	12	4%	18	5%	32,580	5%	14.930.634
Piauí	2	1%	3	1%	8,480	1%	3.281,480
Alagoas	3	1%	5	1%	6,090	1%	3.351.543
Paraíba	3	1%	5	1%	11,800	2%	4.039.277
Midwest	**20**	**7%**	**23**	**6%**	**47,640**	**8%**	**16.504.303**
Federal District	6	2%	3	1%	8,660	1%	3.055.149
Goiás	4	1%	5	1%	20,940	3%	7.113.540
Mato Grosso	4	1%	8	2%	8,120	1%	3.526.220
Mato Grosso do Sul	6	2%	7	2%	9,920	2%	2.809.394
Total	**267**	**100%**	**386**	**100%**	**625,370**	**100%**	**211.755.692**



Graph 1: Correlation between projected new cases of cancer per state and number of CACONs/UNACONs per state.



Graph 2: Correlation between projected new cases of cancer by state and number of radiotherapy centers per state.

such as Roraima and Amapá, which did not have radiotherapy centers.

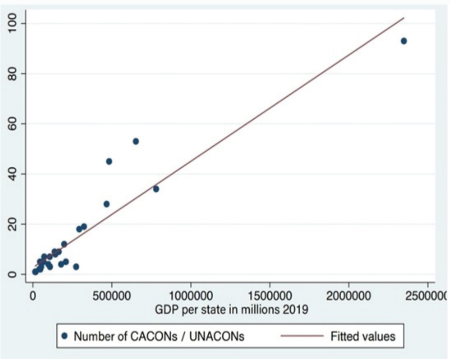
Most likely, the projection of new cases of cancer by state was underestimated in the states where the population has a lower MHDI score, based on education, because populations with lower levels of education tend to seek fewer health services. Subsequently, fewer cases are diagnosed, as evidenced by Albrecht et al. [13]. Thus, there are possibly a greater number of patients for a smaller number of cancer centers in the poorest states.

In contrast, states with a higher projection of new cases of cancer tend to have higher MHDI scores based on education. In a 2013 study, Max Moura de Oliveira et al. [14] found that regions with the highest socioeconomic status had a greater number of available health services and, therefore, a greater chance of obtaining diagnoses. Thus, an increase in the prevalence of a particular disease may indicate that more people have access to health services.

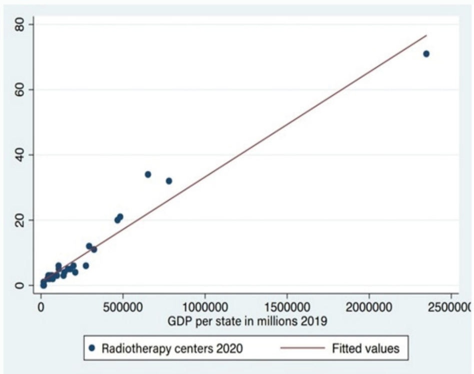
Furthermore, according to the correlation shown in Graph 6,

Table 2: Distribution of GDP values per state in thousands, hospitalizations outside the state of origin, new cases/radiotherapy center, new cases by UNACONs and CACONs, by Brazilian states in 2020, and average HDI based on education, by Brazilian states in 2017.

State/Region	MDHI Education	GDP per state	Hospitalizations outside the State of origin	New cases/Radio Center	New Cases/Cacons and unacons
		R $ in thousands	N	n	N
Southeast		**3.721,317**		**2.159,142**	**1.599,365**
São Paulo	0.828	2.210,562	7,507	2.209,44	1.686,77
Rio de Janeiro	0.763	758,859	-181	2.100,63	1.977,06
Espírito Santo	0.732	137,020	106	3.626,67	1.208,89
Minas Gerais	0.753	614,876	-2,554	1.979,71	1,270
South		**1.195,550**		**2.203,269**	**1.245,320**
Santa Catarina	0.779	298,227	-148	3.041,82	1.761,05
Paraná	0.764	440,029	1,189	1.752,50	1.251,79
Rio Grande do Sul	0.729	457,294	-47	2.193,33	1.023,56
North		**387,535**		**1.547,5**	**1.762,142**
Amapá	0.71	16,795	-263	- -	860
Tocantins	0.727	35,666	-500	2,100	2,100
Rondônia	0.703	44,914	437	1,030	1,545
Amazon	0.735	100,109	-180	1,050	1,750
Acre	0.682	15,331	-262	1,240	1,240
Roraima	0.771	13,370	-266	- -	780
Pará	0.661	161,350	-507	1,850	2.312,50
Northeast		**1.004,828**		**3.492,564**	**2.003,088**
Ceará	0.717	155,904	-118	5,416	3.008,89
Rio Grande do Norte	0.677	66,970	275	5,570	1.591,43
Pernambuco	0.685	186,352	1,214	3,755	1.877,50
Maranhão	0.682	98,179	-540	3,520	2,640
Sergipe	0.64	42,018	-8	1.983,33	1,190
Bahia	0.654	286,240	-754	2,715	1,810
Piauí	0.666	50,378	375	4,240	2.826,67
Alagoas	0.636	54,413	-222	2,030	1,218
Paraíba	0.671	64,374	-928	3.933,33	2,360
Midwest		**694,911**		**2,382**	**2.071,304**
Federal District	0.804	254,817	-3,172	1.443,33	2.886,67
Goiás	0.74	195,682	-3,496	5,235	4,188
Mato Grosso	0.758	137,443	-663	2,030	1,015
Mato Grosso do Sul	0.71	106,969	-1,982	1.653,33	1.417,14
Total		**7.004,141**		**2.432,209**	**1.620,129**



Graph 3: Correlation between GDP per state in millions and number of CACONS/UNACONs per state.

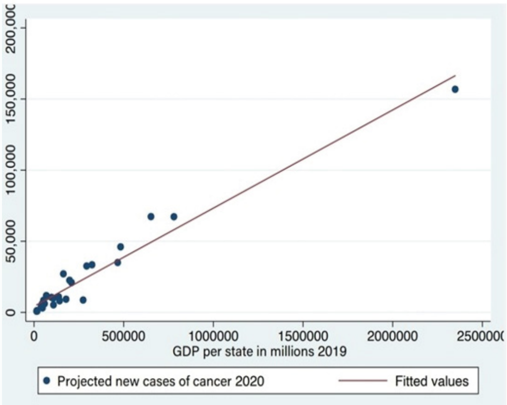


Graph 4: Correlation between GDP per state in millions and number of radiotherapy centers per state.

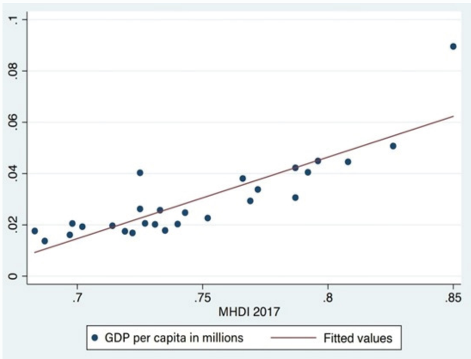
states with higher GDP per capita tend to have higher MHDI score based on education. Thus, it is possible that in these states, there is a greater demand for health services (treatment and prevention) and consequently a greater number of diagnoses.

Thus, it can be assumed that the number of new cases of cancer in the poorest states is underestimated and that part of the population probably did not have access to health services for diagnostics. Thus, if we consider that the number of new cases is underestimated, there would probably be no relationship between the projection of new cases and oncology centers, as there would be more patients for fewer cancer treatment centers. This fact suggests that the distribution of the oncology network is not equitable between the states and their needs.

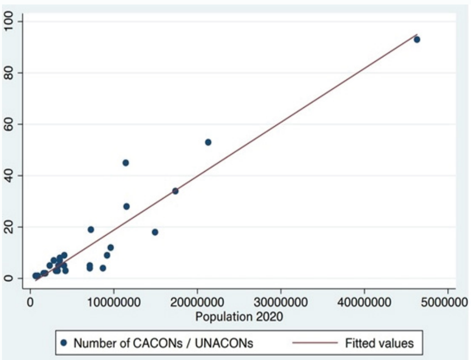
In addition, this imbalance between the sick population and the number of cancer centers may justify migrations between states in search of diagnosis and treatment, which decreases the quality of life of the patient. According to Oliveira et al. [10] the median displacements analyzed for outpatient and surgical treatment of breast cancer are 94 km and 67 km, respectively. These migrations can also generate



Graph 5: Correlation between GDP per state in millions and projected new cases per state.



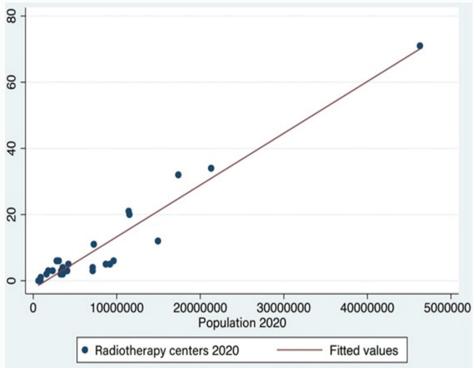
Graph 6: Correlation between average HDI based on education in 2017 and GDP per capita per state in millions.



Graph 7: Correlation between population per state and number of CACONs/ UNACONs per state.

overload in the specialized centers of neighboring states.

The predicted number of new cancer cases for oncology centers helps determine whether the number of centers in particular states can handle the demand. However, in more developed states such as São Paulo, a greater number of new cases per cancer center does not necessarily reveal an imbalance, as in these locations there are larger centers that can accommodate a large number of patients, as is the case of ICESP, IBCC, AC Camargo, among others. In turn, in the less developed states such as PB, AL, RN, high numbers of anticipated cases suggests a lack of balance between the supply of cancer treatment centers and the demand of patients. More centers may be needed in these locations, since the existing treatment centers are smaller than those in larger metropolitan areas.



Graph 8: Correlation between population per state and number of radiotherapy centers per state.

The poorest states may have difficulty acquiring radiotherapy services because the necessary infrastructure is very complex and extremely expensive. States that do not have radiotherapy create a barrier for the treatment of cancer, as this therapeutic modality is an important part in the treatment of various types of cancer. It is not feasible for patients to travel to other locations for each radiotherapy session. Thus, there needs to be a greater public effort and funding from the federal government to obtain specialized services and to offer complete cancer treatment in all states.

Conclusion

Brazil is a heterogeneous country in regard to the distribution of cancer services. Although there is a balance between the numbers shown in the graphs above, we have states with very few oncology and radiotherapy centers, and some with none.

Areas are thus created that are very lacking in oncological services, a fact that generates migration and overload in the services of neighboring states. In addition, the projected data of new cases of cancer by state are probably underestimated in the poorest state, which is due to the lower number of diagnoses, making public health planning in these regions difficult. Thus, it is not possible to say that the distribution of oncology centers across the country is equitable, and the distribution of oncology centers needs to be improved.

References

1. Panamerican Health Organization, informative sheet - câncer. 2018.
2. da Silva JAG. National Cancer Institute. Coordination of prevention and surveillance. Estimate/2014 – Cancer Incidence in Brazil. 2021.
3. Instituto Nacional de Câncer José Alencar Gomes da Silva. Estimate/2014 - Cancer Incidence in Brazil. 2021.
4. Migowski A, Atty ATM, Tomazelli JG, Dias MBK, Jardim BC. A Atenção Oncológica e os 30 Anos do Sistema Único de Saúde. 2021.
5. Secretaria de estado da saúde; coordenadoria de saúde da região metropolitana da grande são paulo; unidade de avaliação e controle; manual de credenciamentos e cadastramentos especiais; Oncologia – CACON. 2021.
6. Sociedade Brasileira de Cirurgia Oncológica (SBCO); Diferenças entre CACON X UNACON. 2021.
7. Instituto Nacional de Câncer. Expansão da assistência oncológica (Projeto EXPANDE). 2021.
8. Política nacional de atenção oncológica. Conselho Nacional dos Secretários da Saúde

(CONASS) NT 26ª 2005. 2021.

9. Ministry of Health. Portaria 874, 16 de maio de 2013. Chap II article 2.

10. Oliveira EXG, Melo ECP, Pinheiro RS, Noronha CP, Carvalho MS. Acesso à assistência oncológica: mapeamento dos fluxos origem-destino das internações e dos atendimentos ambulatoriais. O caso do câncer de mama. Cad Saúde Pública. 2011;27(2):317-26.

11. Cubero DIG, Sette CVM, Piscopo BCP, Monteiro CRA, Schoueri JHM, Tavares HAD, et al. Epidemiological profile of Brazilian oncological patients seen by a reference oncology center of the public health system and who migrate in search of adequate health care. Rev Assoc Med Bras (1992). 2018;64(9):814-8.

12. Instituto Nacional do Câncer José Alencar Gomes da Silva. Ministry of Health, Online atlas of mortality, Death rate by cancer, gross and adjusted by age, world and Brazilian population, gender, locality and period. 2021.

13. Albrecht CAM, Amorimi MHC, Zandonadei E, Viana K, Calheiros JO. Mortalidade por câncer de mama em hospital de referência em oncologia, Vitória, ES. Rev Bras Epidemiol. 2013;16(3):582-9.

14. Oliveira MM, Malta DC, Guauche H, Moura L, Silva GA. Estimate of people diagnosed with cancer in Brazil: data from the National Health Survey, 2013. Rev Bras Epidemiol. 2015;18(Suppl 2):146-57.

15. Federal constituition (Articles 196 to 200) Seção II DA SAÚDE. 1988.