

EXPENSES ON ONCOLOGICAL TREATMENTS DURING THE COVID-19 PANDEMIC IN CEARÁ, NORTHEAST BRAZIL

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Highlights: (1) There was a reduction in expenditures in May and June 2020 and in February, April, and May 2021 (2) Surgical procedures decreased in 2020 and 2021, followed by radiotherapy and chemotherapy in 2020. (3) The findings may support strategies to mitigate higher-than-expected expenditures.

PRE-PROOF

(as accepted)

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ABSTRACT

Objective: To analyze expenses related to cancer treatment during the Covid-19 pandemic in the state of Ceará. **Method:** A descriptive study using expense records from the Ceará Hospital Information and High Complexity Procedure Authorization System, developed in 2022. The data were synthesized using Microsoft Excel 2019®. The following measures were used for descriptive analysis: means, standard deviation, minimums, maximums, and an estimate of the mean treatment cost. **Results:** A reduction in expenses was identified in 2020 (R\$ 3,879,505.41) and 2021 (R\$ 3,088,822.14) compared to 2019. In 2020, the reduction occurred in May (R\$ 2,739,116.44) and June (R\$ 2,633,173.82). In 2021, the months included February (R\$ 3,193,095.98), April (R\$ 3,093,272.64), and May (R\$ 3,093,272.64). Surgery reduced the mean values per procedure in 2020 and 2021 (R\$ 3,626,046.22; R\$ 3,545,102.89), followed by radiotherapy in 2020 (R\$ 166,656.00) and chemotherapy (R\$ 76,320.89) in 2020, with "adjuvant" treatment being reduced in both years (R\$ 95,256.00; R\$ 60,710.50). **Conclusion:** There was a slight reduction in expenses per procedure compared to pre-pandemic levels, but with a relevant assessment considering possible unmet demand during the pandemic.

Keywords: Healthcare expenses. Neoplasms. Coronavirus. Therapeutics.

INTRODUCTION

With the advent of the Covid-19 pandemic, referral centers underwent changes in patient flow and in the provision of treatments due to the repercussions of measures implemented to control the transmission of SARS-CoV-2, such as social distancing and reduced mobility within and between municipalities. Units and referral centers also faced uncertainty arising from the postponement of treatments, as not all cases could safely wait for treatment. Disease progression and negative impacts on survival were major concerns, requiring appropriate management tailored to each patient and their individual needs¹.

In 2020, the National Cancer Institute (INCA) published technical notes recommending the postponement of screening tests and prioritizing diagnostic procedures and

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treatment for positive or symptomatic cases. In the following year, in light of the epidemiological situation and the responses to the health scenario, screening procedures were resumed, with a focus on confirming diagnoses and initiating treatment².

Studies indicate a strong relationship between delays in the diagnosis of breast, head and neck, testicular cancers, and melanoma and unfavorable outcomes³, as well as an inverse association between time to treatment initiation and survival among patients with lung and pancreatic cancer. Furthermore, the limitations imposed by the pandemic led to late diagnoses, resulting in higher costs to the Brazilian Unified Health System (SUS). Prior to the Covid-19 pandemic scenario, cancer treatment cost approximately US\$1.16 trillion per year in 2010. Although all countries were affected to a greater or lesser extent, the repercussions tend to be more severe in those with poorer socioeconomic conditions^{4, 5}.

There is a scarcity of studies on cancer-related expenses in Brazil, particularly during the Covid-19 pandemic period. The present study makes an original contribution, as there are still no analyses addressing the economic repercussions of the Covid-19 pandemic on expenses related to cancer treatment in the state of Ceará. This approach provides an overview of expenses on oncological treatments before and during the Covid-19 pandemic, identifying short-term reductions and the potential future impacts of increased cancer-related expenses beyond those projected in pre-pandemic estimates.

The objective of this study was to analyze expenses on cancer treatment during the Covid-19 pandemic in a state in Northeastern Brazil, Ceará.

METHOD

This descriptive study was conducted using information on expenses related to outpatient and inpatient treatments for cancer patients at cancer care referral units and centers in Ceará. The information was collected from the Ceará State Health Department (SESA/CE), originating from records in the Hospital Information System (HIS) and the Authorization for High Complexity Procedures (HCPA).

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Data collection took place from May to June of 2022, relating to expenses for cancer treatment of patients in the years 2019, 2020, and 2021. For data collection at SESA/CE, the following inclusion criteria were adopted: patient data related to outpatient and inpatient procedures involved in cancer patient care; data on all types of cancer; regarding inpatient procedures, only oncological surgeries were considered. Excluded were: zeroed and incomplete HCPA s; HCPA s and HIAs that were not fully completed.

The information was obtained and organized using spreadsheets with data extracted from HCPA s and Hospital Information Authorization (HIA), separated by the years that made up the historical series. The information corresponded to expenses for procedures registered and paid by HIA and HCPA, with HIAs corresponding to expenses for surgical treatments and HCPA s to outpatient treatments. The expenses incurred with procedures were corrected monthly and annually according to the General Market Price Index (GMP-I).

The data were entered into spreadsheets using Microsoft Excel 2019® (Microsoft Corporation, Redmond, Washington DC, USA). For descriptive analysis of the values related to the cost of procedures in each period, the following measures were used: means, standard deviation, minimums, maximums, and estimate of the mean treatment value.

The term of faithful depositary was used with SESA/CE to authorize the collection of documents. The research received approval from the Ethics and Research Committee of the State University of Ceará (CEP/UECE), under opinion number 5.353.022, dated April 15, 2022.

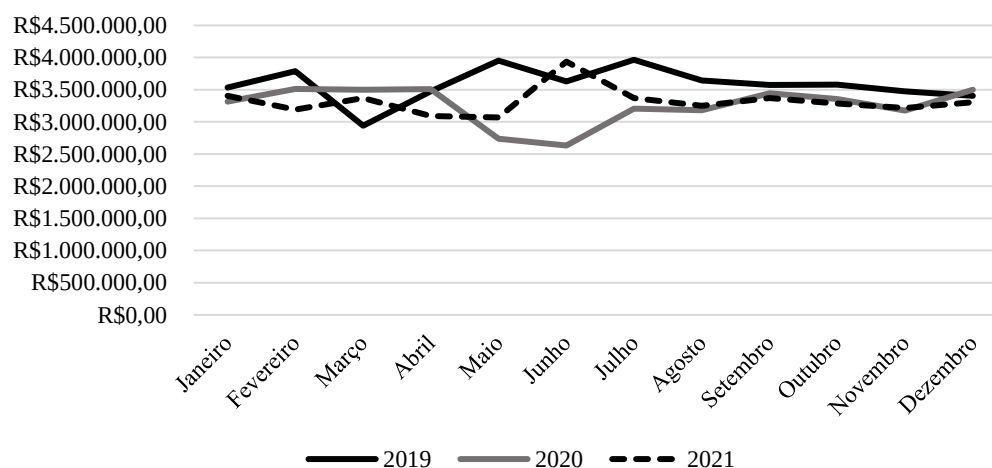
RESULTS

In 2020, the first year of the pandemic, outpatient and surgical procedures to treat cancer patients in Ceará decreased by R\$ 3,879,505.41 compared to 2019. In 2021, the reduction was R\$ 3,088,822.14 compared to 2019. Regarding the types of treatment used, surgery showed the greatest reductions in costs in 2020 and 2021 (respectively R\$ 3,626,046.22; R\$ 3,545,102.89), followed by radiotherapy in 2020 (R\$ 166,656.00) and chemotherapy in 2020 (R\$ 76,320.89), with the greatest reduction in adjuvant chemotherapy [prophylactic – adult in both years, 2020 and 2021 (R\$ 95,256.00; R\$ 60,710.50)]. The annual values were corrected according to the IGP-M for each year studied⁶.

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Regarding the annual and monthly distribution of procedures performed, reductions were identified in both pandemic years compared to 2019. In 2020, the reduction occurred in the months of May (R\$ 2,739,116.44) and June (R\$ 2,633,173.82). In 2021, the months with the most significant reductions when compared to the months of 2019 were February (R\$ 3,193,095.98), April (R\$ 3,093,272.64), and May (R\$ 3,093,272.64), as shown in graph 1.

Graphic 1: Annual and monthly distribution of expenses (R\$) for outpatient and surgical procedures for cancer treatment in Ceará, 2019-2021. Ceará-Brazil, 2022.



Source: Authors, 2022.

Regarding the distribution of values by treatment procedures, Table 1 shows that the mean per number of procedures changed throughout the series. More detailed data on this finding can also be found in the table.

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Table 1: Distribution of expenses (R\$) for outpatient and inpatient procedures, according to therapeutic modality, 2019-2021. Ceará-Brazil, 2022.

Line labels	2019	2020	2021
Nuclear medicine - oncological therapy	18,233.10	7,750.80	5,570.90
Chemotherapy - special procedures	863,565.50	899,248.00	886,185.50
Adjuvant (prophylactic) chemotherapy – adult	1,195,043.50	1,099,787.50	1,134,333.00
Curative chemotherapy – adult	264,594.32	263,153.04	213,492.32
Chemotherapy for childhood and adolescent tumors	137,808.80	201,135.84	236,626.40
Palliative chemotherapy – adult	11,856,414.30	11,835,110.65	12,205,443.65
Previous chemotherapy (neoadjuvant/cytoreductive) – adult	900,899.00	843,569.50	944,475.50
Radiotherapy	8,392,656.00	8,226,000.00	8,449,368.00
Surgery	19,325,301.01	15,699,254.79	15,780,198.12
Total	42,954,515.53	39,075,010.12	39,865,693.39
Adjustment for GMP-I^a	43,200,555.12	39,758,411.25	40,405,922.09

Source: Hospital Information Authorizations (HIA) and High Complexity Procedure Authorizations (HCPA), state of Ceará; Central Bank of Brazil, 2022.
GMP-I^a: Annual General Market Price Index.

Although the total values of chemotherapy did not decrease, when evaluated by type of chemotherapy, a reduction of R\$ 89.08 was identified in the curative chemotherapy modality – adult in 2021, R\$ 27.03 in adjuvant (prophylactic) chemotherapy – adult in 2020, and R\$ 4.46 in 2020 and R\$ 14.21 in 2021 in chemotherapy for tumors in children and adolescents, as shown in Table 2.

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Table 2: Distribution of values (in R\$) presented by outpatient and inpatient treatment procedures, 2019-2021. Ceará-Brazil, 2022.

Procedures	Min.	Max.	$\bar{x}$	SD	$\bar{x}$ proced.
2019					
Nuclear medicine - oncological therapy	443.70	614.70	552.52	83.53	552.52
Chemotherapy - special procedures	0.00	871.00	454.51	49.55	454.51
Adjuvant (prophylactic) chemotherapy – adult	301.50	1,450.00	487.57	407.64	487.57
Curative chemotherapy – adult	1,700.00	2,408.52	1,824.79	234.98	1,824.79
Tumor chemotherapy - child/adolescent	1,381.76	1,700.00	1,680.60	76.62	1,680.60
Palliative chemotherapy – adult	0.00	2,224.00	414.50	374.06	414.50
Previous chemotherapy (neoadjuvant/cytoreductive) - adult	0.00	1,450.00	663.89	462.40	663.89
Radiotherapy	30.00	7,700.00	1,594.35	2,017.64	1,594.35
Surgery	143.72	26,892.35	4,076.21	3,995.45	4,076.21
2020					
Nuclear medicine - oncological therapy	443.70	614.70	553.63	85.03	553.63
Chemotherapy - special procedures	335.00	871.00	457.63	59.06	457.63
Adjuvant (prophylactic) chemotherapy - adult	301.50	1,450.00	460.55	381.81	460.55
Curative chemotherapy - adult	1,700.00	2,408.52	1,827.45	234.76	1,827.45
Tumor chemotherapy - child/adolescent	1,381.76	1,700.00	1,676.13	84.17	1,676.13
Palliative chemotherapy - adult	0.00	2,224.00	421.96	388.28	421.96
Previous chemotherapy (neoadjuvant/cytoreductive) - adult	0.00	1,450.00	745.20	476.86	745.20
Radiotherapy	550.00	5,838.00	3,804.81	1,734.40	3,804.81
Surgery	143.72	27,802.22	4,448.64	4,130.90	4,448.64
2021					
Nuclear medicine - oncological therapy	443.70	614.70	576.70	72.45	576.70
Chemotherapy - special procedures	0.00	871.00	455.15	51.46	455.15
Adjuvant (prophylactic) chemotherapy - adult	0.00	1,450.00	494.05	414.13	494.05
Curative chemotherapy – adult	1,700.00	2,408.52	1,735.71	89.42	1,735.71
Tumor chemotherapy - child/adolescent	1,381.76	1,700.00	1,666.38	98.16	1,666.38
Palliative chemotherapy – adult	0.00	2,224.00	434.93	400.36	434.93
Previous chemotherapy (neoadjuvant/cytoreductive) - adult	301.50	1,450.00	747.80	487.01	747.80
Radiotherapy	1,729.00	5,838.00	3,773.72	1,741.64	3,773.72
Surgery	158.11	31,019.38	4,223.82	4,011.04	4,223.82

Source: Hospital Information Authorizations (HIA) and High Complexity Procedure Authorizations (HCPA), state of Ceará.

SD: Standard deviation

Min: Minimum $\bar{x}$: Mean

Max: Maximum $\bar{x}$ proced: Mean number of procedures.

DISCUSSION

This study aimed to analyze the expenses incurred in treating cancer patients in Ceará during the Covid-19 pandemic. A reduction of R\$ 3,879,505.41 was identified in 2020 and R\$ 3,088,822.14 in 2021, compared to 2019. In 2020, the reduction occurred in the months of May and June. In 2021, the months with the most significant reductions were February, April, and May. Surgery showed the greatest reductions in costs in 2020 and 2021,

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followed by radiotherapy in 2020 and chemotherapy in 2020, with adjuvant (prophylactic) chemotherapy for adults experiencing reductions in both 2020 and 2021.

Regarding the values scored, it should be noted that, according to the Brazilian Institute of Economics (IBRE)⁷, in 2019 the GMP-I was 7.30%, increasing to 23.14% in 2020 and 17.78% in 2021.

It is noteworthy that prior to the COVID-19 pandemic, expenses on oncological treatments had shown a progressive increase. A historical series with national data from 2008 to 2020 analyzed expenses on clinical health procedures and identified a continuous rise over the period, with oncological treatment expenses ranking second. Among clinical modalities, the highest mean expenses were identified for palliative chemotherapy – adult, followed by radiotherapy and adjuvant (prophylactic) chemotherapy – adult. The lowest expenses were associated with nuclear medicine, followed by chemotherapy – special procedures and curative chemotherapy – adult⁸. Another study also observed an increase in the number of hospitalizations of cancer patients in Brazil from 2008 to 2018, which led to higher expenses on oncological treatments throughout the period studied⁹.

The growing economic burden of cancer in Brazil is considered an important public health issue, as studies indicate an increasing trend in the near future. This progressive rise is partly due to the epidemiological and demographic transition process of the population, which has increased in density and longevity, thereby altering the disease profile. Another factor associated with rising expenses on oncological treatments is the incorporation of new technologies into cancer treatment¹⁰.

Although expenses have increased progressively, this does not mean that the population's needs have been fully and satisfactorily met. The treatment of patients with more advanced stages of cancer requires more costly modalities and medications in greater quantities, in addition to longer hospital stays¹¹.

A study conducted by the Oncology Observatory, analyzing federal expenses on cancer, found that expenses on the disease increased by 402% between 2018 and 2022 in the mean cost of cancer treatment procedures (chemotherapy, radiotherapy, and immunotherapy). When evaluated by region, the Northeast showed the highest expenses related to hospitalization (R\$ 1,211.83) and surgery (R\$ 3,805.70)¹². In the following year, a reduction

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in the number of procedures and an increase in their mean cost were also observed¹². Given the increase in expenses, this may be attributed to the expanded use of new technologies and treatments, as well as a reduction in early diagnosis and, consequently, early-stage treatment of the disease, resulting in higher costs to the health system^{13,14}.

Other authors identified national repercussions of COVID-19 on cancer treatment. In 2018, the mean length of hospital stay for neoplasms in Brazil was 5 days, with a mean reimbursement of R\$ 2,107.60. In 2019, the mean length of stay was 4.9 days and the mean amount was R\$ 2,089.42. In 2020, the mean length of stay remained at 4.9 days, while the mean amount increased to R\$ 2,242.98¹⁵.

With the arrival of COVID-19 in Brazil in the early months of 2020, referral centers for oncological care were required to establish protocols to better manage cancer treatments during the period. Screening procedures were canceled for several months, and priority was given to cases with established diagnoses. However, studies identified reductions in hospitalizations and outpatient procedures that were also due to patients' fear of seeking care because of the risk of SARS-CoV-2 infection. This delay in seeking services has implications for delayed diagnosis and initiation of treatment in cancer patients, preventing early and timely therapy, as disease progression to more advanced stages is expected, resulting in higher treatment costs and a worse prognosis for affected individuals^{16,17}.

The months with the greatest declines in expenses on oncological procedures were May and June 2020, during the first phase ("wave") of the COVID-19 pandemic. This period was characterized by the spread of cases from capital cities to inland areas, including peripheral regions, rural zones, and small towns. One of the main initial measures adopted to control SARS-CoV-2 transmission was social isolation; however, adherence was initially higher and gradually declined over time, with this key strategy increasingly discredited as a measure to reduce exposure and ensure collective protection¹⁸.

In 2021, reductions in expenses occurred in February, during the second wave of the COVID-19 pandemic, as well as in April and May, which comprised the third phase. During the second wave, stabilization in transmission and death indicators was observed, alongside an increase in cases, high test positivity, and stabilization in hospitalizations and deaths. At the end of this period, cases and deaths declined due to mobilization by several state and

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municipal governments to adopt physical and social distancing measures and mask use. The third phase was characterized as the third and most lethal wave of the COVID-19 pandemic nationwide. A widespread health system crisis was established, with peaks of up to 4,000 deaths per day and a seven-day moving mean exceeding 3,100 deaths. It is noteworthy that during this period, precarious healthcare not only contributed to higher COVID-19 mortality but also to deaths from various unmanaged chronic diseases¹⁸.

Another study¹⁹ estimated mortality and the economic impact caused by delays in cancer diagnosis in Australia, using data on breast, melanoma, colorectal, and lung cancers. The authors observed an increase of nearly 90 deaths and additional costs exceeding US\$12 million based on a realistic three-month delay. Furthermore, it was estimated that hundreds of life-years could be lost if the initiation of diagnosis were delayed by six months.

The study has some limitations related to the use of records derived from HIA and HCPA forms, which are administrative records used for reimbursement of procedures. Therefore, duplicate entries may exist because the systems do not record possible readmissions and transfers to other institutions. However, working directly with these records makes it possible to identify and quantify potential HCPA and HIA entries not registered in the system.

The study is based on a census sample, allowing for greater external validity, as it included the entire population of the state undergoing oncological treatment within the Unified Health System (SUS). Although the COVID-19 pandemic affected all states in the country, the repercussions in terms of cases and deaths occurred heterogeneously.

CONCLUSION

The study identified reductions in expenses on procedures for cancer treatments in Ceará. It is necessary to identify the current scenario in order to support actions that may mitigate greater burdens resulting from potential unmet demand during the pandemic. It is noteworthy that there is a lack of studies addressing cancer-related expenses in the country, especially during the pandemic, given that these costs had been increasingly rising in light of the country's epidemic context.

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The findings of this study may assist managers and professionals involved in cancer patient care in understanding the scenario triggered by the COVID-19 pandemic, guiding actions and resource reallocation to mitigate future negative repercussions on patients' health, as well as to reduce costs and losses to the SUS.

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