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Cost-utility of palliative care in an oncology institute

Custo-utilidade dos cuidados paliativos em um instituto de oncologia

Costo-utilidad de los cuidados paliativos enun instituto de oncología

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ABSTRACT

Objective: Evaluate the cost-utility of palliative care in oncology, estimating direct medical costs, quality-adjusted life years, and the incremental cost-effectiveness ratio. **Methods:** It is an economic evaluation using a Markov model to compare the costs and outcomes of palliative care and conventional care. The study cohort was composed of 97 patients from four Oncology Units: 16 (16.5%) from Cancer Hospital 1, 20 (20.6%) from 2, 18 (18.6%) from 3 and 43 (44.3%) from 4. Hospitals 1, 2 and 3 provide conventional care and Hospital 4 palliative care. **Results:** Cancer Hospital 4 had the lowest monthly treatment cost at R$ 25,72, compared to Hospital 1 (R$ 128.18), 2 (R$ 267.20) and 3 (R$ 274.30). Sensitivity analysis showed that the results were robust even with variations in parameters. **Conclusion:** The cost-utility analysis demonstrated that the palliative care unit was the most cost-effective alternative compared to the conventional care units. Implementing policies that encourage the adoption of palliative care from diagnosis is recommended to optimize clinical and economic outcomes.

Keywords: Palliatice care, Cancer, Economic evaluation in health, Cost-utility analysis.

RESUMO

Objetivo: Avaliar o custo-utilidade dos cuidados paliativos em oncologia, estimando os custos médicos diretos, os anos de vida ajustados pela qualidade e a relação custo-efetividade incremental. **Métodos:** Trata-se de uma avaliação econômica utilizando um modelo de Markov para comparar os custos e resultados dos cuidados paliativos e dos cuidados usuais. A coorte do estudo foi composta por 97 pacientes de quatro Unidades Oncológicas: n.16 (16,5%) do Hospital do Câncer 1, n. 20 (20,6%), do 2, n. 18 (18,6%) do 3, n. 43 (44,3%) do 4. Os Hospitais 1, 2 e 3 oferecem cuidados usuais e o Hospital 4 cuidados paliativos. **Resultados:** O Hospital do Câncer 4 teve o menor custo mensal de tratamento, R$ 25,72, comparado ao Hospital 1 (R$ 128,18), 2 (R$ 267,20) e 3 (R$ 274,30). A análise de sensibilidade mostrou que os resultados foram robustos mesmo com variações nos parâmetros. **Conclusão:** A análise custo-utilidade demonstrou que a unidade de cuidados paliativos foi a alternativa mais custo-efetiva em comparação com as unidades de cuidados convencionais. Recomenda-se a implementação de políticas que incentivem a adoção de cuidados paliativosdesde o diagnóstico para otimizar os resultados clínicos e econômicos.de políticas que incentivem a adoção de cuidados paliativos desde o diagnóstico para otimizar os resultados clínicos e econômicos.

Palavras-chave: Cuidados paliativos, Câncer, Avaliação econômica em saúde, Análise custo-utilidade.

RESUMEN

Objetivo: Evaluar el costo-utilidad de los cuidados paliativos en oncología, estimando los costos médicos directos, los años de vida ajustados por calidad y la relación costo-efectividad incremental. **Métodos:** Es una

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evaluación económica utilizando un modelo de Markov para comparar los costos y resultados de los cuidados paliativos y los cuidados convencionales en los últimos 30 días de vida. La cohorte de estudio estuvo compuesta por 97 pacientes de cuatro Unidades de Oncología: 16 (16,5%) del Hospital Oncológico 1, 20 (20,6%) del 2, 18 (18,6%) del 3 y 43 (44,3%) del 4. Los hospitales 1, 2 y 3 brindan cuidados convencionales y el Hospital 4, cuidados paliativos. **Resultados:** El Hospital Oncológico 4 tuvo el menor costo mensual de tratamiento, con R$ 25,72, frente a los Hospitales 1 (R$ 128,18), 2 (R$ 267,20) y 3 (R$ 274,30). El análisis de sensibilidad mostró que los resultados fueron sólidos incluso con variaciones en los parámetros. **Conclusión:** El análisis costo-utilidad demostró que la unidad de cuidados paliativos fue la alternativa más costo-efectiva en comparación con las unidades de cuidados convencionales. Se recomienda implementar políticas que fomenten la adopción de cuidados paliativos desde el diagnóstico para optimizar los resultados clínicos y económicos.

Palabras clave: Cuidados paliativos, Cáncer, Evaluación económica en salud, Análisis costo-utilidad.

INTRODUCTION

The rising life expectancy has shifted the leading causes of death towards chronic non-communicable diseases, which are characterized by progressive deterioration, lack of curative treatments and are mainly responsible for compromising the functional capacity of individuals, suffering and death (MENDES EC and VASCONCELLOS LCF, 2025). According to The Global Burden of Disease, they account for 71% of global deaths, with cardiovascular diseases and cancer leading the list (RITCHIE H, et al., 2018). Cancer is a significant global health issue. Its increasing incidence and mortality are linked to socioeconomic factors, environmental conditions, growth and aging populations, besides lifestyle changes (SUNG H, et al, 2021).

The National Cancer Institute (INCA) is the auxiliary body of the Ministry of Health in Brazil and estimated that for the three-year period from 2023 to 2025 there will be 704 thousand new cases of cancer in the country, 483 thousand if cases of non-melanoma skin cancer are excluded (INSTITUTO NACIONAL DO CÂNCER, 2022).The Brazilian National Cancer Institute estimates that 704,000 new cancer cases will occur between 2023 and 2025; 483,000 if cases of non-melanoma skin cancer are excluded (INSTITUTO NACIONAL DE CÂNCER, 2023). Brazil has a national cancer prevention and control policy, including palliative care (BRASIL, 2013 e BRASIL, 2018). However, many patients with incurable cancers continue to receive insufficient, excessive, or unnecessary treatments in hospitals, delaying the initiation of timely palliative care (ROZMAN LM, 2018).

Oncological care in Brazil has had a guiding policy since 2005, guided by Ordinance No. 874, of 5/16/2013, which established the National Policy for the Prevention and Control of Cancer in the Health Care Network (RAS) for People with Chronic Diseases within the scope of the Unified Health System (SUS), including palliative care (PC) (BRAZIL, 2013). Within the scope of the SUS, Resolution No. 41, of October 31, 2018, published by the Ministry of Health (BRAZIL, 2018), presents the guidelines for the organization of PC, in light of the integrated continuing care offered in the RAS, electing for PC any person affected by a life-threatening disease, whether acute or chronic, from the diagnosis of this condition.

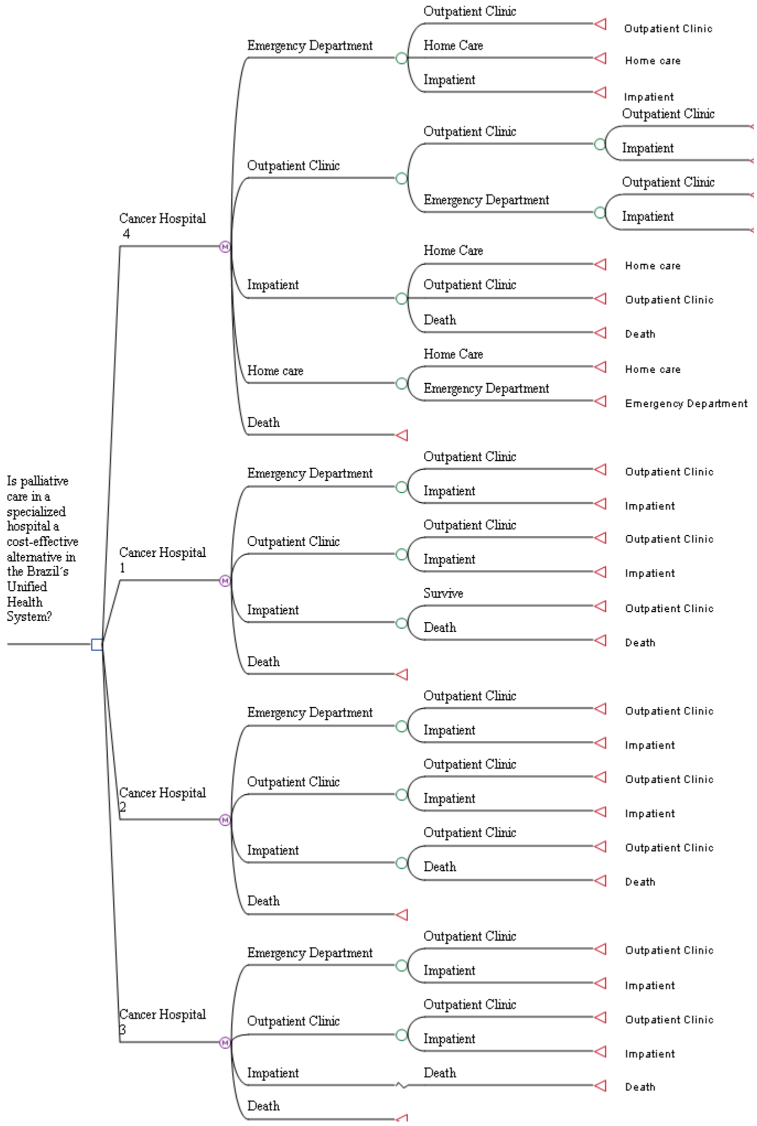
However, it is not uncommon for patients without the possibility of therapy with the objective of curing or modifying the course of the oncological disease, to remain in hospital care units occupying beds, using technological resources, undergoing exams, invasive methods and therapies that are insufficient, excessive and unnecessary, maintaining suffering, increasing costs and often losing the window of opportunity for PC to be initiated at the most opportune time and in hospitals that integrated PC with usual care (ROZMAN, 2018). This study aims to assess the cost-effectiveness of palliative care for oncology patients across four hospitals within a Brazilian cancer institute, one of which specializes in palliative care.

METHODS

The study conducted a cost-utility analysis using data from a retrospective cohort of patients who died in Cancer Hospital 1, 2, 3 and 4 during a specific period. This is a economic analysis focused on comparing the costs and outcomes of standard care versus specialized palliative care, ensuring accurate and contextualized assessment (GRIEVE R, et al., 2005). This study was carried out across the four healthcare units of the National Cancer Institute. Cancer Hospital1 treats both children and adults with a variety of cancers; Cancer Hospital 2 is specialized in gynecological and musculoskeletal cancers; Cancer Hospital 3 focuses on breast cancer, and Cancer Hospital 4 is dedicated to palliative care, exclusively serving patients referred from the other three hospitals. The base case was composed of three reference scenarios: Cancer Hospital 1, Cancer Hospital 2, and Cancer Hospital 3, which are the units that provide usual healthcare for cancer patients. The comparator or alternative scenario was Cancer Hospital 4, which is the specialized palliative care unit.

The cohort consisted of patients who died between August 1st and 31st (month with more days and no holidays), 2019, while hospitalized at one of the National Cancer Institute's facilities. This year was chosen to avoid interference from the COVID-19 pandemic, which could have affected patient referrals and institute operations. Inclusion criteria were: age over 20, advanced-stage cancer with metastasis, enrollment in the Institute for at least 60 days, and referral to Cancer Hospital 4 at least 30 days before death. Exclusion criteria included: diagnosis of cancer less than 60 days before death, cancer surgery, death from a non-cancer-related condition, and missing clinical data. A Markov chain model was used to conduct the cost-utility analysis, as shown in. This model included five health states: outpatient clinic, home care, emergency department, inpatient, and death (**Figure 1**).

Figure 1 - Markov model structure witch the five health states.



Source: Nigri RB, et al., 2025.

Quality-Adjusted Life Years were used as the measure of effectiveness (utility). However, as it was a retrospective study, utilities for each health state were extrapolated from the literature. These authors evaluated quality of life using the EORTC-QLQ C 30 Global Health Status/QOL-scale and the McGill Quality of Life Single Item Scale, applied in the last 30, 90, and 180 days of life. Quality of life 30 days prior to death was estimated at 0.448 (0.399 – 0.498) for those without palliative care and 0.525 (0.478 – 0.572) for those receiving palliative care (VANBUTSELE G, et al., 2018).

The model assumed that patients in Cancer Hospitals 1, 2, and 3 began their journeys in the emergency department or outpatient clinic. In the alternative scenario, Cancer Hospital 4, the journey began in the emergency room, outpatient clinic, or home care. Patients who entered the hospital through the emergency department were discharged to continue follow-up in the outpatient clinic or home care (Cancer Hospital 4) or were admitted. From the moment they entered through the outpatient clinic, they attended and received guidance, remaining in this care process or being admitted. Home care patients (Cancer Hospital 4) received home visits or were seen in the emergency department. In cases of hospitalization, patients were discharged to outpatient follow-up or home care or progressed to death.

The transition probabilities between the health states of the model were defined based on the proportion of patients who were hospitalized, discharged, or died in each of the base case scenarios. Costs were determined using a bottom-up micro-costing method, and items were priced based on information provided by the billing departments of the hospital units. Only direct medical costs were considered in the analysis. The analysis time horizon was 30 days, with 30 Markov cycles and a duration of 24 hours each.

Model uncertainties were explored through multivariate deterministic sensitivity analyses and probabilistic sensitivity analyses using Monte Carlo simulations. The analysis perspective was of the Unified Health System at local level. The model was developed and analyzed using Tree Age® Pro Health Care 2021 software. The main information and characteristics of the study were summarized according to the Consolidated Health Economic Evaluation Reporting Standards - CHEERS Task Force checklist (HUSEREAU D, et al., 2022).

Ethical Aspects

This study presents the results of a doctoral thesis (NIGRI RB, 2024). In compliance with the ethical and scientific principles this research project was submitted to the National Research Ethics Committee of the Federal University of the State of Rio de Janeiro, number 71748523.1.0000.5285, decision number 6.298.83, approved on 09/13/2023, and the National Cancer Institute, number 71748523.1.3001.5274, decision number 6.452.515, approved on 10/24/2023. The research used the secondary database of the National Cancer Institute's information systems from which the necessary information was extracted, without identifying the individuals, and a waiver of the Informed Consent and Assent Term was requested and accepted.

RESULTS

The cohort was composed of 97 patients, of which 16 (16.5%) were from Cancer Hospital 1, 20 (20.6%) from Cancer Hospital 2, 18 (18.6%) from Cancer Hospital 3, and 43 (44.3%) from Cancer Hospital 4. In Cancer Hospital 1, the median age was 65.5; in 2, it was 57.5; in 3, it was 58.0, and in 4, it was 64.0. Regarding patient profile variables, there was a higher prevalence of the female gender (69.1%); 52.6% were brown; 49.5% were Catholic and 38.1% were Evangelical; 44.3% were married; 32% had incomplete elementary education; 100% of the cohort resided in the state of Rio de Janeiro, and of these, 40.2% in the municipality of Rio de Janeiro. Among the most frequent primary cancer sites, breast cancer (20.6%) was observed, followed by cervical cancer (12.4%) and colon cancer (12.4%).

The cost-utility analysis suggests that both Cancer Hospital 4 and 1 may be cost-effective for the treatment of advanced-stage cancer patients, considering a willingness-to-pay of R$ 40,000,00 per Quality-Adjusted Life Year. Cancer Hospitals 2 and 3 were dominated. The Cancer Hospital 4 had the lowest monthly treatment cost at R$ 25.72, compared to Hospital 1 (R$ 128.18), whose cost was 4.98 times greater. Although the average monthly effectiveness may have been 2.33 times higher at Cancer Hospital 1 (0.14 versus 0.06 Quality-Adjusted Life Years), the cost-effectiveness ratio at this hospital was, in the same proportion, 2.18

times higher than at Cancer Hospital 4 (R$ 899.11 versus R$ 412.06). The model therefore suggests that Cancer Hospital 4 was the unit with the lowest cost-effectiveness ratio (**Table 1**).

Table 1 - Cost-utility analysis report.

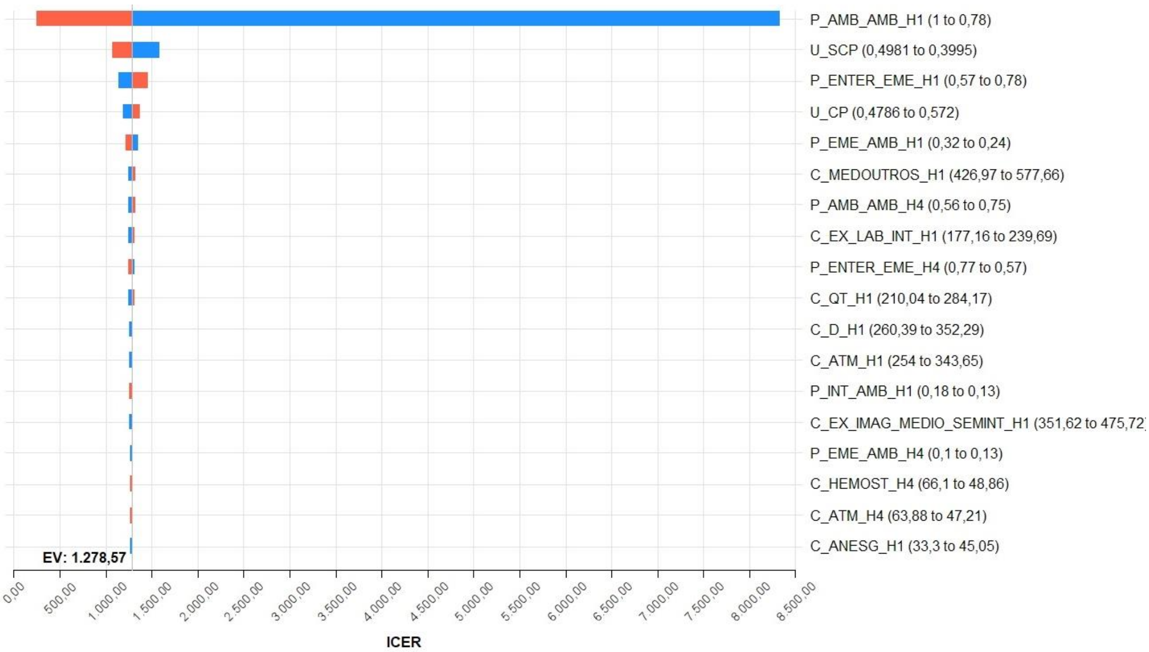
Estrategy	Cost (R$)	Incremental Cost	Effectiveness	Effectiveness Incremental	Incremental Cost-Effectiveness Ratio	Net Monetary Balance	Cost-effectiveness
Hospital 4	25,72	-	0,06	-	-	2.471,47	412,06
Hospital 1	128,2	102,45	0,14	0,08	1.278,57	5.574,25	899,11
Hospital 2	267,2	138,97	0,09	-0,06	-2.443,47	3.160,33	3.117,71
Hospital 3	274,3	146,16	0,11	-0,03	-4.743,49	4.195,59	2.454,95

Source: Nigri RB, et al., 2025. **Note:** Costs in Real (R$)

Sensitivity analysis

Multivariate sensitivity analysis suggests that parameter variations didn't significantly impact model results to cause changes in the cost-effectiveness threshold, considering the expected incremental cost-effectiveness ratio (R$ 1,278.57) and willingness-to-pay for Quality Adjusted Life Years of the R$ 40,000.00 (**Graphic 1**).

Graphic 1 - Tornado Diagram: Incremental Cost-Effectiveness Ratio (ICER) of the cancer hospital 4 *vs*. cancer hospital 1



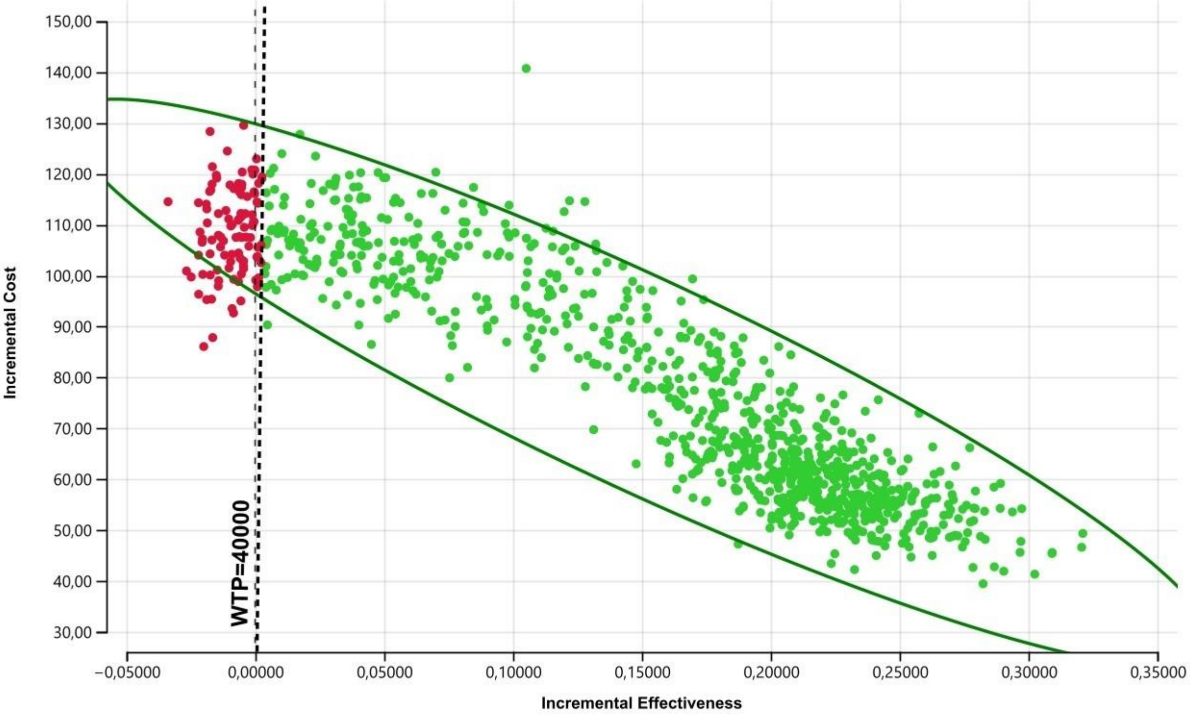
Source: Nigri RB, et al., 2025.

The most impactful variable was "Probability of remaining in the outpatient clinic at Cancer Hospital 1." Lower probability increases the incremental cost-effectiveness ratio up to ~R$ 8,000.00 (at 0.78 probability). However, the incremental cost-effectiveness ratio could be much lower than R$ 250.00, if the probability were 1. Depending on willingness-to-pay monthly, lower probability of these patients continuing outpatient treatment and requiring hospitalization at Cancer Hospital 1, increases the chance of this hospital being dominated by Cancer Hospital 4.

It's important to highlight that the willingness-to-pay of R$ 40,000.00 for Quality-Adjusted Life Year considers the annual cost, not the monthly cost. This is the time horizon over which costs were estimated in the proposed analytical model. Therefore, the willingness-to-pay per month for an additional Quality-Adjusted Life Year would be R$ 3,333.33, significantly lower than the expected value for a Quality-Adjusted Life Year (R$ 8,000.00) if the probability of keeping this patient in the outpatient clinic is 78%.

Parametric uncertainties were also explored through probabilistic sensitivity analyses, using 10,000 Second Order Monte Carlo simulations. Scatter plots of the incremental cost-effectiveness ratio and acceptability curve were plotted, focusing on the two cost-effective strategies: Cancer Hospitals 4 and 1(**Graphic 2**).

Graphic 2- Scatter plot of Incremental Cost-Effectiveness comparing Cancer Hospital 1 with Cancer Hospital 4 considering the willingness to pay R$40,000.00.



Source: Nigri RB, et al., 2025.

In the graph, it is possible to observe a greater proportion of iterations (combinations) considered cost-effective, represented by green dots, revealing, in comparison, a greater proportion of iterations that favor Cancer Hospital 1. The results of 10,000 Monte Carlo simulations, show the absolute and relative frequencies of iterations distributed across components C1 to C6 and their respective quadrants I to IV. 90.4% of iterations were cost-effective when comparing Cancer Hospital 1 and 4, with the highest proportion in component C2 (quadrant I). This component is characterized by increased costs and effectiveness, but the incremental cost-effectiveness ratio remains below the willingness-to-pay threshold of R$ 40,000.00. Therefore, these iterations were considered cost-effective (**Table 2**).

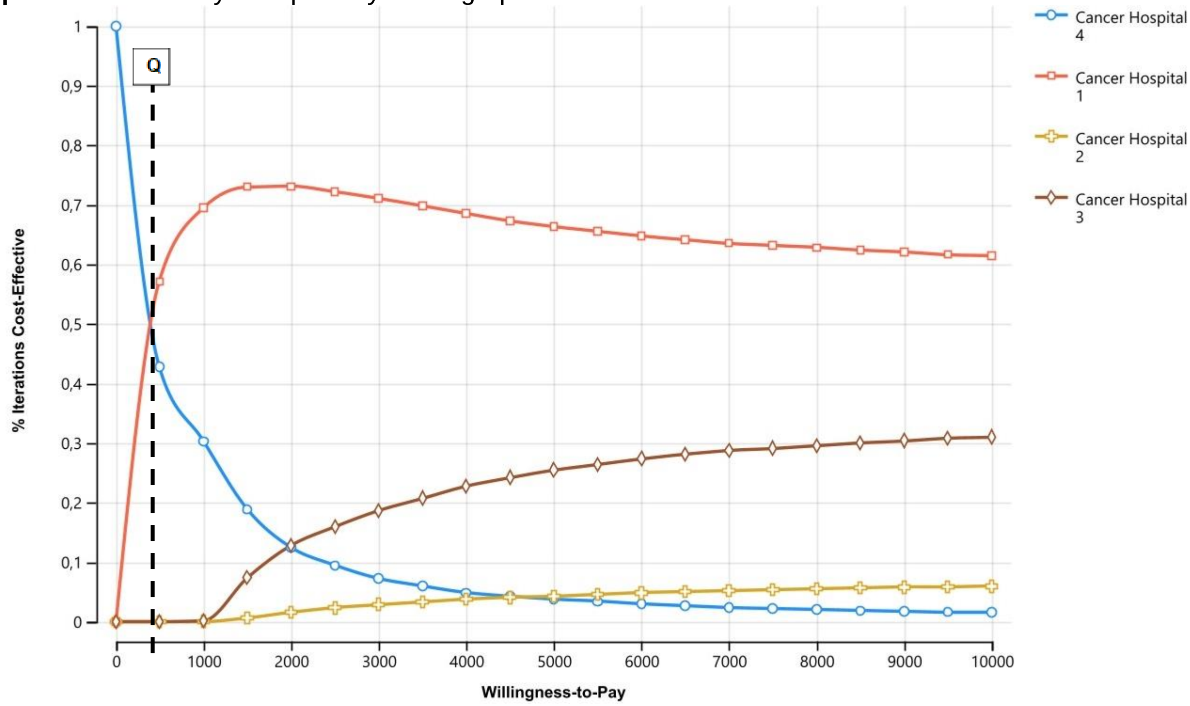
Table 2 - Incremental cost-effectiveness dispersion report considering a willingness to pay monthly for Quality Adjusted Life Years of R$ 40,000.00.

Component	Quadrant	Incremental Effectiveness	Incremental Cost	Incremental Cost-Effectiveness	Frequency	Proportion
C1	IV	IE>0	IC<0	Superior	0	0
C2	I	IE>0	IC>0	ICER<40,000.0	9.043	0.904
C3	III	IE<0	IC<0	ICER>40,000.0	0	0
C4	I	IE>0	IC>0	ICER>40,000.0	101	0.01
C5	III	IE<0	IC<0	ICER<40,000.0	0	0
C6	II	IE<0	IC>0	Inferior	856	0.085

Source: Nigri RB, et al., 2025.

No iterations were observed in components C1 and C5, although they would also be considered cost-effective. Only 8.5% of iterations were deemed non-cost-effective (C6). Components C3 and C4 were considered predictors of non-effectiveness, as the incremental cost-effectiveness ratio would result in values higher than the willingness-to-pay threshold in both cases. The acceptability curve, shows the probability of hospitals being cost-effective strategies for patients at the National Cancer Institute, considering a willingness-to-pay range of R$ 0 to R$ 10,000.00. The maximum willingness-to-pay threshold in the acceptability curve was set in accordance with the mean incremental cost-effectiveness ratio of R$ 1,278.47 and one-twelfth of the annual willingness-to-pay from the model (R$ 40,000.00).

Graphic 3 - Cost-utility acceptability curve graph.



Source: Nigri RB, et al., 2025.

The Point 'Q' on the graph represents a willingness-to-pay of R$ 400.00 where both interventions, Cancer Hospital 4 an Hospital 1 have a 50% probability of being cost-effective. As the most cost-effective alternative, Cancer Hospital 4 has a 100% probability of being cost-effective, even with a willingness-to-pay of R$ 200.00 per month for additional Quality-Adjusted Life Years. The curve indicates that values above R$ 400.00 increase the probability of Cancer Hospital 1 being the cost-effective strategy, rather than Cancer Hospital 4, corroborating the results of the incremental cost-effectiveness ratio scatter plot shown previously. Cancer Hospital 1 has the highest probability (70%) of being cost-effective when the willingness-to-pay is between R$ 1,400.00 and R$ 2,000.00. However, this probability decreases to 60% as willingness-to-pay increases beyond R$ 10,000.00.

DISCUSSION

The cost of care for patients hospitalized at Cancer Hospital 4 was lower than in standard care units (Cancer Hospitals 1, 2, and 3), which corroborates with literature findings that predict lower costs for patients receiving palliative care.11-14 In the context of cancer, it is evident that different therapies often involve high costs and can have significant adverse effects. For patients without prospect of cure, the efficiency of these treatments is often minimal, given the need to reallocate resources from other healthcare areas that could benefit much more (O'MAHONY S, et al., 2005; CHEUNG MC, et al., 2015; ROZMAN LM, et al., 2021 and PARACKAL A, et al., 2021).

The disparities found in the analyzed scenarios reveal, beyond the peculiarities of each unit, a complexity that needs to be considered in the analysis. From this perspective, sensitivity analyses balanced these complex factors. For example, when considering the introduction or continuation of medications or diagnostic tests for a patient who is theoretically eligible for palliative care, it is crucial to understand that the immediate cost is important. However, it is equally relevant to know how different efficacy scenarios, the use of these diagnostic and therapeutic resources, and the variation of associated costs may influence the overall value over time.

Sensitivity analyses helped to comprehensively capture these dynamics, as they are powerful tools capable of exploring the uncertainties related to the observed differences in the analyzed scenarios, providing a more complete view of the possible outcomes (RIVEROS BS, et al., 2016). Such results should support decision-makers in understanding the impacts of their decisions in patient's life, optimizing resource allocation, increasing transparency, and ultimately improving patient outcomes. Probabilistic sensitivity analysis using Monte Carlo simulations was crucial for understanding the impact of extreme changes in parameters, such as significant variations in drug costs or length of hospitalization. Studies have shown that analyzing extreme scenarios helps identify intervention viability limits (MOSADEGHRAD AM, et al., 2022).

It should be emphasized that the sensitivity analyses conducted were based on a cost-utility perspective, measuring incremental costs versus incremental effectiveness in terms of Quality-Adjusted Life Years. The results of the analysis demonstrated that both Cancer Hospital 4 and 1 showed superiority in terms of cost-effectiveness when compared to Cancer Hospitals 2 and 3, even under wide variations in model parameters. Kyeremanteng, et al. (2018) also found evidence that palliative care units are consistently more cost-effective due to their focus on quality of life and adequate symptom management.

Monte Carlo simulations also revealed that a vast majority of simulated iterations (green dots) favored Hospital 1 (usual care) over Hospital 4 (palliative care), suggesting that Hospital 1 could also be cost-effective considering the willingness to pay. The simulation of possible scenarios projects the future in the medium or long term, reinforcing the importance of considering the cost-benefit ratio to avoid interventions that, although clinically effective, may not be economically sustainable. This is aligned with the literature that suggests the need for a balance between cost and effectiveness in resource allocation decisions (LAKDAWALLA D, et al,. 2021).

The ability to provide a high quality of life at an acceptable cost is a key factor that makes palliative care in a specialized unit a viable choice for health systems seeking to maximize the efficiency and effectiveness of interventions (MATEUS CM, et al, 2020). However, the increasing demand for palliative care in the coming years may strain the healthcare system, leading to increased budgetary impacts due to the need to care for these patients, which could compromise the sustainability of the Unified Health System. In this sense, it is essential that managers establish a willingness-to-pay threshold to guide decisions about which technologies should be incorporated and adopted, ensuring that resources are used efficiently (THOKALA P, et al., 2018).

Furthermore, advanced cancer has intangible costs of physical, psychosocial, and spiritual nature, in addition to debilitating symptoms such as pain. This confirms the need to integrate palliative care from the beginning of treatment for adequate symptom management to ensure comfort and quality of life for patients (BITTENCOURT NCC M, 2021). From the perspective that mantaining treatments and postponing death can increase costs. Moreover, the efficiency, and consequently, the quality of care delivered to these patients and their families cannot be evaluated only by the length of time the patient is kept alive, but rather by the quality of life provided and the monetary effort required to achieve it (FREITAS R, et al., 2022). In dynamic models such as Markov used for economic cost-utility analyses, the longer the individual remains alive over the time horizon of the analysis, the more utility (quality of life) he or she accumulates.

It is important to note that when assessing an individual's Quality-Adjusted Life Years, it is imperative to consider their quality of life before and after the disease, as well as the different stages or severity and treatments, which can either enhance or diminish their quality of life. From this perspective, prolonging the life of a patient with advanced-stage cancer without considering their quality of life may, in some cases, constitute therapeutic obstinacy. Maintaining patients alive at any cost, not only direct or indirect monetary costs, but also intangible ones such as psychological, emotional, and physical suffering of patients and families, is not in line with the principles and goals of palliative care.

The study's limitations are related to the short time frame of only one month for collecting deaths, which may raise doubts about the possibility of finding the same results in other periods. The utility parameters used in the model were extrapolated from non-Brazilian realities, but it was the best available evidence that could be used at the time. The micro costing does not address analytical uncertainties and the particularities of each patient. The study evaluates the quantity of interventions but not the clinical indication that would justify or not the adopted conduct, which can be considered a bias. To address these issues, new studies evaluating the justifications for the interventions should be conducted.

CONCLUSION

Although the economic analysis results have suggested that Cancer Hospitals 4 and 1 are cost-effective alternatives for caring for advanced cancer patients who are indicated for palliative care, it is important to emphasize that to maximize the benefits of caring for patients, a sustained investment in the ongoing training of healthcare professionals is essential. The effectiveness of palliative care depends on the competence of professionals, and continuing education programs are fundamental to maintaining high standards of care.

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