ORIGINAL ARTICLE

Analysis of Anticancer Drugs Used to Treat Brain Cancer Using the Cheapest and Costliest Drugs in India: A Cost-comparison Health Economics Study

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Abstract

Background: Brain tumors are among the most aggressive malignancies requiring multimodal therapy, including chemotherapy. In India, where healthcare is predominantly financed out of pocket, the cost of anticancer medications poses a significant barrier to treatment adherence. A wide disparity exists between the costliest branded drugs and their lower-cost alternatives, raising concerns about affordability and equity in care. This study aimed to perform a cost-minimization analysis (CMA) to quantify cost differences (CDs) among the most expensive, least expensive, and generic chemotherapy drugs used for brain tumor treatment.

Materials and methods: This descriptive pharmacoeconomic study compared the costs of eight chemotherapy agents—temozolomide, procarbazine, lomustine, carmustine, vincristine, bevacizumab, irinotecan, and carboplatin. Drug prices were sourced from the Current Index of Medical Stores (CIMS) and government databases. Dosages were standardized based on average Indian adult body surface area (BSA). Cost metrics included CD, cost ratio (CR), and percentage cost variation (PCV). Regimen-wise costs were calculated per cycle and overall.

Results: Significant cost variation was observed across all formulations. Temozolomide 250 mg showed the highest fold difference (8.94×), while bevacizumab displayed a 3.3× difference. Adjuvant temozolomide over 12 months ranged from ₹32,220 (generic) to ₹3,90,000 (costliest brand). PCV values ranged from 27.7% (carboplatin) to over 700% (temozolomide). Most CDs were statistically significant ($p < 0.05$).

Conclusion: This study highlights substantial pricing disparities in chemotherapy for brain tumors in India. Cost-effective alternatives can significantly reduce treatment-related financial toxicity. Incorporating pharmacoeconomic evidence into prescribing decisions is essential to improve equitable access to neuro-oncology care.

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Introduction

The annual incidence of brain neoplasms on a global scale is estimated to be 3,21,731 new cases, with a corresponding mortality rate of 2,48,500 individuals per year. In the context of the Indian subcontinent, the situation is notably severe, as evidenced by the documented yearly occurrence of brain tumors amounting to 32,574, accompanied by a fatality rate of 27,990.[1] From an anatomical perspective, brain tumors, which include various types of cancerous growths, impact the central nervous system and necessitate a thorough and frequently intensive treatment plan, which may involve surgical intervention, radiation therapy, and chemotherapy.[2] The substantial mortality rate, when compared to the occurrence rate, highlights the crucial difficulties encountered in the areas of accessible treatment, healthcare provision, and the urgent requirement for improvements in both clinical management and supportive care frameworks to reduce the illness and death linked to brain neoplasms.[1]

Pharmacoeconomic studies are increasingly focusing on the economic implications of treating brain tumors, which are a serious health concern and present a twin challenge of clinical care and cost burden.[3,4] The financial burden linked to the treatment of brain tumors is further intensified in contexts such as India, where a substantial portion of the population confronts the harsh truth of personally financing healthcare costs due to the restricted availability of health insurance coverage.[5,6]

The financial impact of brain tumor therapy extends beyond the direct expenses of treatment and includes indirect costs associated with decreased productivity and income, exacerbating the financial hardship experienced by affected families. This situation is especially severe when it comes to brain tumors, as the duration of treatment is protracted and typically accompanied by substantial illness, resulting in prolonged periods of being unable to work or experiencing long-term disability. In the context of India, where a substantial proportion of healthcare expenditure—exceeding two-thirds—is borne by individuals themselves, the selection of treatment modalities and medications is profoundly impacted by their financial implications. Consequently, the affordability of pharmaceuticals assumes a pivotal role in shaping treatment choices.[7,8]

The wide range of chemotherapy brands for treating brain tumors demonstrates a diverse range of cost implications, with certain brands being priced excessively high while others are more affordable. This price disparity emphasizes a substantial obstacle, showcasing a wide range between the most economical and the most costly therapy choices accessible to consumers.[9] This inequality not only demonstrates the financial obstacles in obtaining the best possible healthcare but also emphasizes the need for efforts to close the divide, guaranteeing that good treatment remains accessible to all groups of people dealing with brain tumors.[10]

The Indian government implemented a scheme with the objective of mitigating the economic strain associated with healthcare costs. This initiative seeks to improve the availability of cost-effective generic pharmaceuticals in several therapeutic domains such as cancer. It has played a crucial role in offering affordable treatment

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choices.[11,12] However, the primary problem lies in the price difference between generic pharmaceuticals and their branded counterparts, especially in the field of brain tumor chemotherapy.[9,13]

Due to the substantial cost ramifications linked to the treatment of brain tumors and the pivotal role of chemotherapy in this context, there exists an urgent requirement for a comprehensive pharmacoeconomic evaluation. This analysis aims to examine the cost dynamics associated with the treatment of brain tumors in the Indian market, encompassing a range of pharmaceutical alternatives that span from the most cost-effective to the most costly. The objective of this study is to assess the cost-effectiveness of using generic medications compared to branded pharmaceuticals for treating brain tumors through a thorough cost-minimization analysis (CMA).[14]

Materials and Methods

This descriptive pharmacoeconomic study aimed to evaluate the cost disparities between chemotherapy drugs used in the treatment of brain tumors in India. The study was designed to compare three tiers of drug pricing—the most expensive branded version, the least expensive branded version, and the lowest-cost generic alternative. The primary objective was to conduct a CMA to highlight the differences in treatment costs without compromising therapeutic equivalence. Secondary objectives included calculating the percentage cost variation (PCV), cost ratio (CR), and absolute cost difference (CD) for each drug and chemotherapy regimen analyzed.

Drug pricing information was collected from two principal sources. Branded drug prices were obtained from the Current Index of Medical Stores (CIMS), a widely accepted database used in clinical and pharmacoeconomic evaluations in India.[15] Prices of generic formulations were collected from the Pharmaceuticals and Medical Devices Bureau of India (PMBI) and the official generics formulary booklet.[16] The analysis focused on eight commonly prescribed chemotherapy drugs in brain tumor treatment—temozolomide, procarbazine, lomustine, carmustine, vincristine, bevacizumab, irinotecan, and carboplatin.

The inclusion criteria consisted of drugs that are part of standard therapeutic regimens for brain tumors based on the National Comprehensive Cancer Network (NCCN) and European Society for Medical Oncology (ESMO) guidelines.[17,18] Both curative and palliative regimens were included. Drugs not used in brain tumors or those used solely in supportive care (e.g., antiemetics and corticosteroids) were excluded.

Dosages were standardized using average Indian adult body surface area (BSA), based on demographic norms provided by the National Institute of Nutrition, Hyderabad (males: 60 kg, 1.67 m; females: 55 kg, 1.60 m).[19] Dosage per cycle was calculated for each drug and scaled according to a six- or 12-cycle regimen, as applicable. For carboplatin, dosing was adjusted using creatinine clearance and glomerular filtration rate (GFR), assuming a normalized serum creatinine of 0.7 mg/dL.[20]

Statistical Analysis

Three primary cost metrics were calculated:

Cost difference = cost of most expensive brand – cost of generic alternative.[14]

Cost ratio = cost of most expensive brand / cost of generic alternative.[14]

Percentage cost variation = [(cost of most expensive brand – cost of generic alternative) / cost of generic alternative] × 100.[14]

All costs were calculated in Indian rupees (₹), and drug regimens were evaluated per treatment cycle and overall course to ensure comparative uniformity.

Results

The cost analysis included eight chemotherapy agents commonly employed in the treatment of brain tumors, with cost data stratified by the most expensive brand, the least expensive brand, and the lowest-priced generic alternative. The chemotherapy drugs compared in this study included temozolomide, procarbazine, lomustine, carmustine, vincristine, bevacizumab, irinotecan, and carboplatin. Cost comparisons were performed at both the unit level (per drug dosage) and the regimen level (per cycle and total treatment course), with analyses conducted separately for male and female patients.

Unit-level Cost Comparison

As shown in Table 1, the price variations between the costliest and the most affordable versions of the same chemotherapeutic agents were substantial. Temozolomide (250 mg) exhibited a maximum fold difference of 8.94 between its highest-priced brand and the generic formulation, followed by bevacizumab (400 mg), which had a 4.12-fold difference. Carboplatin (150 mg) and irinotecan (100 mg) also showed significant fold differences of 2.64 and 4.54, respectively. PCV was particularly high for temozolomide (553.04%) and irinotecan (354.37%).

Drugs such as lomustine, carmustine, and procarbazine showed lower fold differences (1.29–1.48), indicating relatively less pricing disparity among available brands. Nevertheless, even modest variations become clinically relevant when extrapolated over extended treatment durations.

Regimen-level Cost Comparison—Male Patients

Table 2 presents detailed cost data for chemotherapy regimens calculated for a male BSA of 1.78 m^2. When temozolomide was administered alongside radiotherapy, the cumulative cost for 42 days ranged from ₹12,289.2 (generic) to ₹1,17,969.6 (costliest brand), reflecting a nearly 9.6-fold difference. Similarly, for adjuvant temozolomide over 6 months, the total cost was ₹16,110 (generic) vs ₹1,44,000 (costliest brand). A full 12-month adjuvant regimen led to a cost escalation from ₹32,220 to ₹2,88,000.

Combination regimens showed compounding effects. The temozolomide + bevacizumab regimen cost as much as ₹22,02,468 over 12 cycles with branded drugs, whereas the same could be delivered for ₹7,02,000 using more affordable options. Bevacizumab + irinotecan was the most expensive regimen, costing ₹23,46,576 over 12 cycles with the highest-priced brands. The generic version resulted in a 3.19-fold cost reduction.

The PCV regimen (procarbazine, lomustine, vincristine) showed more moderate variation, with six-cycle costs ranging from ₹10,999.5 (cheapest brand) to ₹14,530.2 (costliest), suggesting lower variability in older regimens.

Regimen-level Cost Comparison—Female Patients

Table 3 demonstrates CDs for female patients, calculated for a BSA of 1.57 m^2. Similar patterns of price disparity were observed. For a 42-day course of temozolomide with radiotherapy, the cost ranged from ₹12,289.2 (generic) to ₹99,111.6 (most expensive brand), yielding a 706.49% PCV. The full 12-month adjuvant temozolomide regimen ranged from ₹32,220 to ₹2,88,000.

For bevacizumab-based regimens, total treatment costs varied dramatically. A 12-cycle bevacizumab course ranged from ₹5,88,000 to ₹19,62,336 (3.34-fold difference), while the bevacizumab + irinotecan regimen showed a total variation from ₹7,23,144 to ₹22,98,540.

Carboplatin regimens were relatively affordable and exhibited less cost variation, with 12-cycle costs ranging from ₹40,968 to ₹71,424. Despite lower PCV values compared to other regimens, the cumulative cost

Table 1: Details of cost (in rupees) for different chemotherapy regimens used to treat brain cancers

	Drug cost			*Actual difference*			*Fold difference*			*PCV*		
Drug	*JAS*	*Costly*	*Cheap*	*Costly–cheap*	*Costly–JAS*	*Cheap–JAS*	*Costly/cheap*	*Costly/JAS*	*Cheap/JAS*	*Costly vs cheap*	*Costly vs JAS*	*Cheap vs JAS*
Temozolomide (20 mg)	NA	449	103.8	345.2	NA	NA	4.33	NA	NA	332.56	NA	NA
Temozolomide (100 mg)	292.6	1910.8	329.8	1581	1618.2	37.2	5.79	6.53	1.13	479.38	553.04	12.71
Temozolomide (250 mg)	537	4800	650	4150	4263	113	7.38	8.94	1.21	638.46	793.85	21.04
Procarbazine (50 mg)	NA	39.6	30.5	9.1	NA	NA	1.29	NA	NA	29.84	NA	NA
Vincristine (2 mg)	NA	111	53	58	NA	NA	2.09	NA	NA	109.43	NA	NA
Lomustine (40 mg)	NA	132	89.25	42.75	NA	NA	1.48	NA	NA	47.89	NA	NA
Carmustine (100 mg)	NA	5175	3625	1550	NA	NA	1.43	NA	NA	42.76	NA	NA
Bevacizumab (400 mg)	NA	123506	30000	93506	NA	NA	4.12	NA	NA	311.69	NA	NA
Bevacizumab (100 mg)	NA	20011	9500	10511	NA	NA	2.11	NA	NA	110.64	NA	NA
Irinotecan (100 mg)	NA	4003	881	3122	NA	NA	4.54	NA	NA	354.37	NA	NA
Carboplatin (450 mg)	1707	2976	2330	646	1269	623	1.28	1.74	1.36	27.72	74.34	36.49
Carboplatin (150 mg)	375	992	714	278	617	339	1.39	2.64	1.91	38.93	164.53	90.41

JAS, Jan Aushadhi Scheme; NA, not applicable; PCV, percentage cost variation

savings from choosing generics remained significant.

Discussion

This study showed significant CD in chemotherapeutic drugs used for brain tumor treatment in India, particularly when one considers the most costly brands, the least expensive brands, and the most affordable generic substitutes. Such price differences—at both the unit and regimen levels—have important consequences for access, equity, and financial cancer care toxicity. Developing educated prescribing practices and policy interventions depends on an awareness of the causes of these discrepancies.

Of all the medications studied, temozolomide—the first-line treatment for high-grade gliomas and glioblastoma—showed the greatest price range, with a fold difference of up to 8.94 for the 250 mg strength and a PCV over 700% in women. Several elements help to explain this. First, temozolomide is a patented, orally given molecule that was first offered as a breakthrough medication. Many brands still promote it at greater price after patent expiration, exploiting its key importance in neuro-oncology. By comparison, a study by Kolasani et al. on chemotherapy pricing in India revealed that temozolomide showed one of the highest cost ranges among oral agents for solid tumors, particularly in neurological cancers.[21] Likewise, Mahal et al. underlined that new, orally delivered medications tend to exhibit unequal price retention even in generic-dominant areas because of doctor knowledge and patient choice for particular brand.[22]

In combination treatments like temozolomide + bevacizumab and bevacizumab + irinotecan, monoclonal antibody targeting VEGF, bevacizumab, exhibited one of the most notable CDs. Branded bevacizumab's total treatment cost over 12 cycles surpassed ₹22 lakh; switching to more reasonably priced alternatives cut expenses by almost 70%. This result corresponds to the difficulties in India's biologics and biosimilars sector. Though biosimilar versions of bevacizumab are authorized, Chhabra et al. and Joshi et al. show that adoption stays low.[23,24] Doubt about interchangeability, immunogenicity, and uneven doctor confidence drives the reluctance. Though India's active biosimilar sector, prescriber-level inertia and insufficient postmarket pharmacovigilance have hampered cost-based switching in neuro-oncology. Though execution is still lacking, the World Health Organization (WHO) has pushed for more biosimilar use to lower expenses in cancers dominated by biologics. The disparity is also maintained by lack of strong comparative efficacy studies, cold-chain handling logistical issues, and originator brand pricing policies.

On the contrary, older medications such as procarbazine, vincristine, lomustine, carmustine, and carboplatin showed less price difference, usually in the range of 1.2–2.0-fold. This lower difference could indicate the long-standing presence of several generic rivals, which would cause price normalization. Carboplatin, for example, an alkylating agent used in many different tumor kinds, had a PCV of 74.3%, fairly low in comparison to more recent medications.

Krishna et al. found comparable trends in chemotherapy pricing for breast and gastrointestinal (GI) cancers, where long-standing cytotoxics like 5-FU and paclitaxel exhibited little price difference owing to strong competition and well-established manufacturing routes.[13]

The sharp difference between unit- and regimen-level expenses draws attention to a vital but usually ignored truth—financial toxicity is cumulative. A single dose of temozolomide, for instance, might seem fairly affordable, but when multiplied over 42 days (concurrent with radiotherapy) or extended into 6- or 12-month adjuvant regimens, the price difference becomes staggering. This result supports the idea of "time toxicity," which emphasizes how long regimens not only increase clinical load but also financial strain.[25] Patients on 12-month adjuvant temozolomide in our study experienced a 9× cost disparity between branded and generic choices. These extended periods increase tiny per-unit cost variations, which leads to significant out-of-pocket costs.

Using average BSA values of men and women—separate calculations for male and female patients revealed minor variations in total drug consumption but comparable patterns in pricing differences. Though the cost percentage variances stayed constant across both groups, female patients had somewhat lower dose requirements.

The results of this study are consistent with previous Indian pharmacoeconomic studies such as those by Adwal and Baghel and Patil et al., which found that anticancer medications in India frequently exhibit CD of >100%, particularly where price control is lacking or nonexistent.[26,27] Though India's difference is usually larger because of the lack of a centralized insurance system, studies conducted abroad have found comparable

Table 2: Details of cost (in rupees) per cycle and the whole regimen for different chemotherapy regimens used to treat brain tumors in Indian males

Regimen name and drugs		*Male (calculated for 1.78 BSA)*		*Male per dose*			*Male total cost calculation*			*Actual difference*			*Fold difference*			*PCV*		
		mg/m²	*Dosage needed*	*JAS*	*Costly*	*Cheap*	*JAS*	*Costly*	*Cheap*	*Costly–cheap*	*Costly–JAS*	*Cheap–JAS*	*Costly/cheap*	*Costly/JAS*	*Cheap/JAS*	*Costly vs cheap*	*Cheap vs JAS*	*Cheap vs JAS*
RT + temozolomide (1 dose)		75	133.5	292.6	2808.8	537.4	292.6	2808.8	537.4	2271.4	2516.2	244.8	5.22	9.59	1.83	422.66	859.94	83.66
Final cost 42 days							12289.2	117969.6	22570.8	95399	105680.4	10281.6	5.22	9.59	1.83	422.66	859.94	83.66
Adjuvant temozolomide 6 months		150	267	537	4800	650	537	4800	650	4150	4263	113	7.38	8.94	1.21	638.46	793.85	21.04
Total for 1 cycle							2685	24000	3250	20750	21315	565	7.38	8.94	1.21		638.46	793.85
Final cost (6 cyles)							16110	144000	19500	124500	127890	3390	7.38	8.93	1.21	638.46	793.85	21.042
Adjuvant temozolomide 12 months		150	267	537	4800	650	537	4800	650	4150	4263	113	7.38	8.93	1.21	638.46	793.85	21.04
Total for 1 dose							537	4800	650	4150	4263	113	7.38	8.93	1.21	638.46	793.85	21.04
Total for 1 cycle							2685	24000	3250	20750	21315	565	7.38	8.93	1.21	638.46	638.46	21.04
Final cost (12 cycles)							32220	288000	39000	249000	255780	6780	7.38	8.93	1.21	638.46	793.85	21.04
PCV regimen	Procarbazine	60	106.8	NA	109.8	91.5	NA	1537.2	1281	256.2	NA	NA	1.2	NA	NA	20	NA	NA
	Lomustine	110	195.8	NA	662.5	446.25	NA	662.5	446.25	216.25	NA	NA	1.48	NA	NA	48.46	NA	NA
	Vincristine	1.4	2.492	NA	111	53	NA	222	106	116	NA	NA	2.09	NA	NA	109.43	NA	NA
Total for 1 cycle							NA	2421.7	1833.25	588.45	NA	NA	1.32	NA	NA	32.09	NA	NA
Final cost (6 cycles)							NA	14530.2	10999.5	3530.7	NA	NA	1.32	NA	NA	32.09		NA
Bevacizumab (1 cycle)		10 mg/kg	650	NA	183539	58500	NA	183539	58500	125039	NA	NA	3.14	NA	NA	213.74	NA	NA
Final cost (12 cycles)							NA	2202468	702000	2202468	NA	NA	3.14	NA	NA	313.74	NA	NA
Temozolomide–bevacizumab	Temozolomide	150	267	537	4800	650	NA	4800	650	4150	NA	NA	7.38	NA	NA	638.46	NA	NA
	Bevacizumab	10 mg/kg	650	NA	183539	58500	NA	183539	58500	125039	NA	NA	3.14	NA	NA	213.74	NA	NA
Total for 1 cycle temozolomide							NA	24000	3250	20750	NA	NA	7.38	NA	NA	638.46	NA	NA
Total for 1 cycle bevacizumab							NA	183539	58500	125039	NA	NA	3.14	NA	NA	213.74	NA	NA
Total cost for 6 cycles temzolomide							NA	144000	19500	124500	NA	NA	7.38	NA	NA	638.46	NA	NA
Total cost for 12 cycles bevacizumab							NA	2202468	702000	1500468	NA	NA	3.14	NA	NA	213.741	NA	NA
Bevacizumab–irinotecan	Bevacizumab	10 mg/kg	650	NA	183539	58500	NA	183539	58500	125039	NA	NA	3.14	NA	NA	213.74	NA	NA
	Irinotecan	125	222.5	NA	12009	2643	NA	12009	2643	9366	NA	NA	4.54	NA	NA	354.37	NA	NA
Total for 1 cycle							NA	195548	61143	134405	NA	NA	3.19	NA	NA	219.82	NA	NA
Final cost (12 cycles)							NA	2346576	733716	1612860	NA	NA	3.19	NA	NA	219.82	NA	NA
Carboplatin (1 cycle)		560	900	3414	5952	4660	3414	5952	4660	1292	2538	1246	1.27	1.74	1.36	27.72	74.34	36.49
Final cost (12 cycles)							40968	71424	55920	15504	30456	14952	1.27	1.743	1.36	27.72	74.34	36.49

JAS, Jan Aushadhi Scheme; NA, not applicable; PCV, percentage cost variation

Table 3: Details of cost (in rupees) per cycle and the whole regimen for different chemotherapy regimens used to treat brain cancers in Indian females

Regimen name and drugs		*Female (calculated for 1.57 BSA)*		*Female per dose*			*Female total cost calculation*			*Actual difference*			*Fold difference*			*PCV*		
		mg/m²	*Dosage needed*	*JAS*	*Costly*	*Cheap*	*JAS*	*Costly*	*Cheap*	*Costly–cheap*	*Costly–JAS*	*Cheap–JAS*	*Costly/cheap*	*Costly/JAS*	*Cheap/JAS*	*Costly vs cheap*	*Cheap vs JAS*	*Cheap vs JAS*
RT + temozolomide		75	117.75	292.6	2359.8	433.6	292.6	2359.8	433.6	1926.2	2067.2	141	5.44	8.06	1.48	444.23	706.49	48.18
Final cost for 42 days							12289.2	99111.6	18211.2	80900.4	86822.4	5922	5.44	8.06	1.48	444.23	706.49	48.18
Adjuvant temozolomide 6 months		150	235.5	537	4800	650	537	4800	650	4150	4263	113	7.38	8.93	1.21	638.46	793.85	21.04
Total for 1 cycle							2685	24000	3250	20750	21315	565	7.38	8.93	1.21	638.46	793.85	21.04
Final cost (6 cycles)							16110	144000	19500	124500	127890	3390	7.38	8.93	1.21	638.46	793.85	21.04
Adjuvant temozolomide 12 months		150	235.5	537	4800	650	537	4800	650	4150	4263	113	7.38	8.93	1.21	638.46	793.85	21.04831
Total for 1 cycle							2685	24000	3250	20750	21315	565	7.38	8.93	1.21	638.46	793.85	21.04
Final cost (12 cycles)							32220	288000	39000	249000	255780	6780	7.38	8.93	1.21	638.46	793.85	21.04
PCV	Procarbazine	60	94.2	NA	79.2	61	NA	1108.8	854	254.8	NA	NA	1.29	NA	NA	29.83	NA	NA
	Lomustine	110	172.7	NA	662.5	446.25	NA	662.5	446.25	216.25	NA	NA	1.48	NA	NA	48.45	NA	NA
	Vincristine	1.4	2.198	NA	111	53	NA	222	106	116	NA	NA	2.09	NA	NA	109.43	NA	NA
Total for 1 cycle								1993.3	1406.25	587.05	NA	NA	1.41	NA	NA	41.74	NA	NA
Final cost (6 cycles)								11959.8	8437.5	3522.3	NA	NA	1.41	NA	NA	41.74	NA	NA
Bevacizumab (1 cycle)		10mg/kg	550	NA	163528	49000	NA	163528	49000	114528	NA	NA	3.34	NA	NA	233.73	NA	NA
Final cost (12 cycles)							NA	1962336	588000	1374336	NA	NA	3.33	NA	NA	233.73	NA	NA
Temozolomide–bevacizumab	Temozolomide	150	235.5	537	4800	650	NA	4800	650	4150	NA	NA	7.38	NA	NA	638.46	NA	NA
	Bevacizumab	10mg/kg	550	NA	163528	49000	NA	163528	49000	114528	NA	NA	3.33	NA	NA	233.73	NA	NA
Total for 1 cycle temozolomide								24000	3250	20750	NA	NA	7.38	NA	NA	3192.31	NA	NA
Total for 1 cycle bevacizumab								163528	49000	114528	NA	NA	3.34	NA	NA	233.73	NA	NA
Total cost for 6 cycles temzolomide								144000	19500	124500	NA	NA	7.38	NA	NA	19153.85	NA	NA
Total cost for 12 cycles bevacizumab								1962336	588000	1374336	NA	NA	3.34	NA	NA	2804.77	NA	NA
Bevacizumab–irinotecan	Bevacizumab	10 mg/kg	650	NA	183539	58500	NA	183539	58500	125039	NA	NA	3.13	NA	NA	213.74	NA	NA
	Irinotecan	125	196.25	NA	8006	1762	NA	8006	1762	6244	NA	NA	4.54	NA	NA	354.37	NA	NA
Total for 1 cycle							NA	191545	60262	131283	NA	NA	3.18	NA	NA	217.85	NA	NA
Final cost (12 cycles)							NA	2298540	723144	1575396	NA	NA	3.17	NA	NA	217.85	NA	NA
Carboplatin (1 cycle)		560	879.2	3414	5952	4660	3414	5952	4660	1292	2538	1246	1.27	1.74	1.36	27.72	74.34	36.49
Final cost (12 cycles)							40968	71424	55920	15504	30456	14952	1.27	1.74	1.36	27.72	74.34	36.49

JAS, Jan Aushadhi Scheme; NA, not applicable; PCV, percentage cost variation

differences.[26] National formularies and universal coverage in countries like the UK or Canada lessen such variation. But in India, low retail reliance and inadequate public procurement policies put consumers at risk of price changes.

Moreover, lack of consistent hospital-based formularies in most cancer centers results in varied prescribing practices. For instance, one hospital might choose more expensive brands depending on doctor preference or distributor connections, but another might give generics top priority because of institutional policy or patient financial limits.

Despite regulatory bioequivalence criteria, oncologists have long been worried about the perceived inferiority of generics. Past incidents of subpar manufacturing, inadequate packaging, or bioavailability discrepancies contribute to this doubt. Though Indian generics are exported and approved by rigorous agencies like the United States Food and Drug Administration (US FDA), local adoption is hindered by the absence of visible pharmacovigilance and patient outcomes tracking. Over 60% of oncologists polled in a 2023 qualitative study voiced concerns about moving to generics in critical care environments such as neuro-oncology.[28] Their worries mostly focused on insufficient efficacy data, poor toxicity reporting, and legal responsibility in case of negative results.

Given the important results of this study, oncologists, pharmacists, and legislators have to coordinate their efforts to reduce financial toxicity in brain tumor treatment. The present situation is an inflection point—where affordability, accessibility, and clinical efficacy have to converge to make cancer treatment truly inclusive. Reaching this objective calls for a joint effort including doctors, patients, legislators, and pharmaceutical interests.

Conclusion

The emphasis should now be on evaluating the clinical outcomes of generic medications using observational studies and randomized trials. Future studies can guarantee that affordability and effectiveness coexist in the control of brain tumors by means of economic analysis combined with clinical validation.

Data Availability Statement

All data supporting the findings of this study are available from the corresponding author upon reasonable request. Requests must be submitted *via* email and accompanied by an official letter on the requesting individual's institutional letterhead.

Ethical Statement

This study utilized secondary data available in the public domain and did not involve any human participants or patient-identifiable information. Hence, it was exempted from full ethical review.

Author Contributions

All authors contributed equally to the conceptualization, methodology, data collection, analysis, manuscript writing, and revision. All authors have read and approved the final version of the manuscript.

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