Pharmacy Reports

https://doi.org/10.51511/pr.119

ORIGINAL ARTICLE

Open Access

Cost of illness of breast cancer in Indonesia in 2024: an analysis from the payer perspective

Sudewi Mukaromah Khoirunnisa[1*], Didik Setiawan[2,3]

[1]Department of Pharmacy, Institut Teknologi Sumatera, South Lampung 35365, Indonesia

[2]Faculty of Pharmacy, Universitas Muhammadiyah Purwokerto, Banyumas 53182, Indonesia

[3]Centre for Health Economic Studies, Universitas Muhammadiyah Purwokerto, Banyumas 53182, Indonesia

[*]Corresponding author: Jl. Terusan Ryacudu, Way Hui, Kec. Jati Agung, South Lampung, Lampung 35365, Indonesia.
Email: sudewi.mukaromah@fa.itera.ac.id

Abstract: Breast cancer imposes a substantial clinical and economic burden in Indonesia, particularly within the National Health Insurance system administered by BPJS Kesehatan. Understanding cost variation by disease severity and care type is therefore essential for efficient resource allocation. This retrospective observational study used BPJS Kesehatan claims data to estimate annual direct medical costs from the payer perspective, categorizing expenses into chemotherapy, radiotherapy, surgery, diagnostic procedures, and follow-up examinations. Costs were analyzed by outpatient versus inpatient care and inpatient severity levels (mild, moderate, severe). The total annual direct medical cost reached IDR 834.11 billion. Outpatient care accounted for the largest share of total expenditure, while inpatient care incurred substantially higher per-patient costs. Costs increased consistently with severity across all components, with chemotherapy, surgery, and radiotherapy identified as the main cost drivers, particularly in severe inpatient cases. Median cost differences between outpatient care and all inpatient severity levels were statistically significant ($p<0.001$). These findings highlight the significant financial burden of breast cancer on Indonesia's national health insurance system, strongly influenced by disease severity and inpatient utilization, and underscore the importance of early detection and optimized outpatient care to improve efficiency and long-term sustainability of cancer care financing under Indonesia's national health insurance system (*JKN*).

Keywords: Breast cancer, direct medical cost, disease severity, inpatient care, outpatient care

Introduction

Breast cancer is the most frequently diagnosed cancer among women worldwide and remains a major contributor to cancer-related morbidity and mortality. Globally, approximately 2.3 million new cases of breast cancer were diagnosed in 2022, with an estimated 685,000 deaths, making it the most common cancer and a leading cause of cancer death among women [1]. Based on current demographic trends and risk factor exposures, projections suggest a substantial increase in both incidence and mortality by mid-century [2]. Breast cancer cases worldwide are expected to rise to approximately 3.2 million new cases per year by 2050, with an estimated 1.1 million breast cancer-related deaths annually [2]. These increasing trends highlight the growing urgency for healthcare systems, particularly in low- and middle-income countries, to strengthen cancer prevention, early detection, and sustainable financing strategies.

In Indonesia, breast cancer represents a significant public health burden. According to GLOBOCAN 2022 estimates, breast cancer was the most common cancer among females, with 66,271 new cases in 2022, accounting for approximately 30.1% of all female cancer cases, and was a major contributor to cancer mortality with an estimated 25,070 deaths, corresponding to a mortality rate of 16.6 per 100,000 women [1]. At the national level, claims-based evidence from Indonesia has demonstrated a steadily increasing trend in breast cancer cases and healthcare utilization over recent years, with breast cancer ranking among the leading causes of cancer-related expenditure within the national health insurance system [3]. Furthermore, a substantial proportion of patients were reported to present at advanced stages, which was associated with higher healthcare resource use and increased economic burden on the health system, as documented in previously published national analyses using *BPJS Kesehatan* data [3]. Without effective policy responses and updated monitoring data, the increasing burden of advanced-stage breast cancer may further strain healthcare resources and threaten the long-term

sustainability of Indonesia's universal health coverage system.

Despite improvements in cancer care access under Indonesia's national health insurance system (*Jaminan Kesehatan Nasional*, JKN) administered by the Indonesian Health and Social Security Agency (BPJS Kesehatan) [4], many patients are still diagnosed at advanced stages[5], contributing to higher treatment costs, poorer outcomes, and elevated mortality [6–9]. Early detection and timely treatment remain challenges in achieving improved survival rates across regions[10,11]. These challenges underscore the importance of generating current national evidence to support more effective cancer control strategies and equitable healthcare planning across Indonesia.

Understanding the economic burden of breast cancer is essential from the payer perspective, particularly in settings with universal health coverage where resource allocation and sustainability are critical. Cost of illness studies provide essential evidence on the magnitude and distribution of disease-related expenditures, supporting evidence-based decision-making in benefit design, reimbursement policy, and health technology assessment.

Despite growing interest in the economic burden of cancer in Indonesia, updated and comprehensive national-level evidence using recent claims data remains limited. Previous studies have explored the economic burden of breast cancer using hospital-based data, regional samples, or earlier waves of national insurance claims, reporting substantial direct medical costs and highlighting inpatient care and systemic therapies as major cost drivers [8,12–14]. However, these studies were often limited by restricted geographical coverage, older data periods, or partial cost components. The absence of recent nationwide evidence limits the ability of policymakers to accurately assess current financial pressures, prioritize healthcare resources, and evaluate the sustainability of cancer financing within the JKN system. Therefore, this study aimed to estimate the cost of illness of breast cancer in Indonesia in 2024 from the payer perspective using BPJS Kesehatan claims data, providing up-to-date evidence to inform policy and planning.

Methods

Study design and data source

This study employed a retrospective observational design using individual-level administrative health insurance claims data from the National Insurance Sample Data (NHISD) provided by BPJS Kesehatan. The analysis specifically utilized claims data from January to December 2024, representing healthcare services reimbursed during the 2024 calendar year. BPJS Kesehatan covers approximately 90% of the Indonesian population under the Jaminan Kesehatan Nasional (JKN) scheme. The NHISD database contains anonymized, individual-level information on patient demographics, clinical diagnoses, healthcare utilization, and reimbursed costs for both inpatient and outpatient services delivered across all contracted healthcare facilities in Indonesia [15]. BPJS Kesehatan claims data were used because they provide nationwide coverage of healthcare utilization and reimbursement data under Indonesia's universal health coverage system, allowing population-level estimation of breast cancer-related healthcare expenditures from the payer perspective.

The analysis was conducted from the payer perspective and included all eligible patients with complete cost and clinical information within the study period. The dataset comprised detailed records on healthcare utilization, disease severity, care setting, hospital characteristics, and direct medical costs reimbursed by the BPJS Kesehatan.

Study population

All insured individuals with at least one claim containing the ICD-10 code C50 during the study period were included in the analysis. Inclusion criteria consisted of patients with complete demographic and healthcare utilization information available in the database. All identified breast cancer cases had complete associated demographic and healthcare utilization information. As the NHISD is based on finalized administrative claims submitted for reimbursement, participants were excluded only if essential variables required for the analysis (e.g., age or diagnosis year) were missing, as the NHISD is based on finalized administrative claims submitted for reimbursement.

Anonymized breast cancer records captured healthcare utilization across primary and secondary care settings, patient demographic characteristics (unique patient identifier, year of diagnosis, sex, age, inpatient class, and insurance enrollment segment), clinical information (discharge status and disease severity), and reimbursed treatment costs.

Disease severity was determined using four-digit Indonesian Case-Based Group (INA-CBG) codes

defined by BPJS Kesehatan, which reflect the number and complexity of documented complications and comorbidities. Severity levels were classified as: outpatient care; mild inpatient care (without complications or comorbidities); moderate inpatient care (with minor complications or comorbidities); severe inpatient care (with major complications or comorbidities).

Type of care was categorized as outpatient or inpatient. Cost variables represented verified reimbursement amounts paid by BPJS Kesehatan for services rendered. It should be noted that suspected or rule-out diagnoses were not separately recorded in the NHISD dataset; all claims included in this analysis therefore carried a confirmed C50 diagnosis code as recorded in the finalized reimbursement data.

Outcomes and cost estimation

Study outcomes were derived from the annual number of breast cancer cases recorded in the National Health Insurance Sample Data (NHISD) database during January–December 2024. Descriptive outcomes included patient demographic characteristics and patterns of healthcare utilization according to type of care and disease severity. Economic outcomes comprised the total annual direct medical cost of breast cancer care from the payer perspective, estimated by aggregating verified reimbursement amounts paid by BPJS Kesehatan across all eligible claims.

The analysis included only direct medical costs covered by BPJS Kesehatan. Cost components consisted of outpatient care costs (including consultations, diagnostic procedures, radiotherapy, chemotherapy, and other therapeutic interventions), inpatient care costs (including hospitalization, diagnostic services, medical procedures, surgery, radiotherapy, and accommodation), as well as supporting services such as laboratory examinations and imaging procedures. Non-medical costs (e.g., transportation and caregiver expenses) and indirect costs (e.g., productivity losses) were not included in the analysis.

A bottom-up (micro-costing) approach was applied to estimate direct medical costs by identifying all breast cancer–related healthcare services utilized during the 2024 study period and summing the corresponding reimbursement amounts paid by BPJS Kesehatan. All costs were calculated and reported in Indonesian Rupiah (IDR; 2024 prices), reflecting the actual reimbursement values recorded in the BPJS Kesehatan claims database. Because all claims data were derived from a single calendar year (2024), inflation adjustment was not necessary. For reference, the approximate exchange rate at the time of the study was IDR 15,767.66 per USD 1.00 (Bank Indonesia median rate in 2024); however, all primary analyses and reported values are presented in IDR, as purchasing power parity adjustment was also not applied because the primary objective of this study was to estimate the direct medical costs of breast cancer from the Indonesian healthcare payer perspective using actual reimbursement expenditures within the national health insurance system. Reporting costs in local currency was considered more appropriate for informing national healthcare financing and policy decisions.

Costs were analyzed according to care setting (outpatient versus inpatient), disease severity level, and patient subgroups. Average annual costs per patient were also calculated to estimate the economic burden at the individual level. To generate nationally representative estimates, analyses applied individual sampling weights defined as constant expansion factors accounting for the representativeness of the NHISD sample by sex, age group, and insurance enrollment segment.

Descriptive analyses were conducted to summarize costs across disease severity categories and cost components. Because healthcare cost data were non-negative and right-skewed, continuous variables were summarized using medians and interquartile ranges (IQR, reported as Q1-Q3), while categorical variables were presented as frequencies and proportions. Median cost differences between disease severity groups were calculated using outpatient care as the reference category. Statistical significance of differences in median costs was assessed using the Wilcoxon rank-sum test. Ninety-five percent confidence intervals (95% CIs) for median differences were estimated using non-parametric bootstrap resampling with 1,000 iterations. A two-sided p value < 0.05 was considered statistically significant.

To identify factors associated with annual direct medical costs, multivariable regression analysis was performed using a generalized linear model (GLM) with Gamma distribution and log link function, reflecting the skewed distribution of healthcare cost data. The dependent variable was total annual direct medical cost per patient, while independent variables included disease severity, type of care, hospital class, geographic region, age group, and insurance enrollment segment.

Table 1. Demographic characteristics of breast cancer patients in Indonesia in 2024

Variable	n	Percentage (%)
Sex		
Male	155	0.30
Female	51,010	99.70
Age		
Mean (SD)	49.6 (11.7)	
Median [min, max]	48.0 [18.0, 88.0]	
Age categories		
0-29	1,537	3.00
30-34	2,612	5.11
35-39	2,895	5.66
40-44	6,966	13.61
45-49	14,260	27.87
50-54	9,336	18.25
55-59	5,871	11.47
60-64	2,504	4.89
65-69	1,783	3.48
70+	3,401	6.65
Marital status		
Not married	4,326	8.45
Married	41,201	80.53
Divorced	5,207	10.18
Undefined*	431	0.84
Inpatient class		
Class I	17,504	34.36
Class II	5,892	11.57
Class III	27,765	54.27
Healthcare facility type (FKRTL)		
Hospital	51,158	99.99
Utama clinic	7	0.01
Healthcare facility type details (FKRTL)		
Class A hospital	8,550	16.71
Class B hospital	12,135	23.72
Class C hospital	3,902	7.63
Class D hospital	772	1.51
Type A equivalent private hospital	1,724	3.37
Type B equivalent private hospital	10,061	19.67
Type C equivalent private hospital	8,333	16.29
Type D equivalent private hospital	1,288	2.52
Armed forces/police hospital class I	478	0.93
Armed forces/police hospital class II	763	1.49
Armed forces/police hospital class III	613	1.20
Armed forces/police hospital class IV	25	0.05
Surgery specialty	175	0.34
Cancer specialty (oncology)	2,346	4.58

*Undefined marital status indicates records for which this information was not available in the NHISD database and should be considered missing data.

Note: Equivalent private hospitals refer to privately managed hospitals categorized by BPJS Kesehatan as having service capacity equivalent to government hospital classifications.

Outpatient care served as the reference category for disease severity. Model coefficients were exponentiated and presented as cost ratios (CRs) with corresponding 95% confidence intervals and p-values. A cost ratio greater than one indicated higher costs relative to the reference group.

Statistical analysis

All statistical analyses were performed using R (version 4.5.2; R Foundation for Statistical Computing, Vienna, Austria) and RStudio (version 2026.01.0+392). Data management and descriptive analyses were conducted using the *dplyr* package. Non-parametric tests were implemented using base R functions, and multivariable regression analyses were performed using the *glm* function. Model estimates and confidence intervals were extracted using the *broom* package. All tests were two-sided, with statistical significance defined as $p < 0.05$.

Results

Patient characteristics

In 2024, a total of 51,165 breast cancer patients were identified in the NHISD database. The study population was predominantly female (99.70%), with males accounting for only 0.30% of cases. The mean age was 49.6 years (standard deviation [SD] 11.70), with a median age of 48.0 years (range: 18–88 years). The largest proportion of patients was observed in the 45–49 years age group (27.9%), followed by those aged 50–54 years (18.30%) and 40–44 years (13.60%), indicating that breast cancer cases were concentrated among women in middle adulthood (Table 1).

Most patients were married (80.53%), while 10.18% were divorced and 8.4% were not married. A small proportion (0.84%, n = 431) had undefined marital status, representing records for which this information was unavailable in the database. Regarding healthcare utilization, more than half of patients were treated under class III inpatient coverage (54.27%), followed by class I (34.36%) and class II (11.57%). Almost all services were delivered at hospital-level facilities (99.99%), with negligible utilization of primary referral clinics. Among hospitals, care was most frequently provided at class B public hospitals (23.72%) and type B equivalent private hospitals (19.6%), followed by class A public hospitals (16.71%) and type C equivalent private hospitals (16.29%). Specialized oncology services accounted for 4.58% of facility utilization, while surgical and pulmonary specialties represented less than 1% of encounters.

Disease severity

Based on INA-CBG severity classification, the majority of breast cancer cases in 2024 were categorized as severe, accounting for 63.0% (n = 32,235) of all patients (Table 2). Moderate severity cases comprised 24.6% (n = 12,560), while mild cases represented 12.5% (n = 6,370) of the study population. This distribution indicates that a substantial proportion of patients required intensive and resource-demanding care, which has important implications for healthcare utilization and cost burden from the payer perspective.

Table 2. Distribution of breast cancer patients based on severity level and type of care

Variable	n=51,165*	Percentage (%)
Severity level		
Severe	32,235	63.00
Mild	6,370	12.45
Moderate	12,560	24.55
Type of care		
Inpatient	3,786	7.40%
Outpatient	47,379	92.60%

*Case counts for type of care represent weighted estimates based on NHISD individual sampling weights (expansion factors accounting for representativeness by sex, age group, and insurance enrollment segment) and may therefore be non-integer values. Severity-level counts represent unweighted observed frequencies.

Type of care

In 2024, the majority of breast cancer–related healthcare utilization occurred in the outpatient setting, accounting for 92,60.8% (weighted n = 47,379) of all cases. In contrast, inpatient care represented 7,40% (weighted n = 3,786) of total utilization. This pattern indicates that while most breast cancer management was delivered on an outpatient basis, a smaller proportion of patients required hospitalization, which is typically associated with higher treatment intensity and greater costs from the payer perspective (Figure 1).

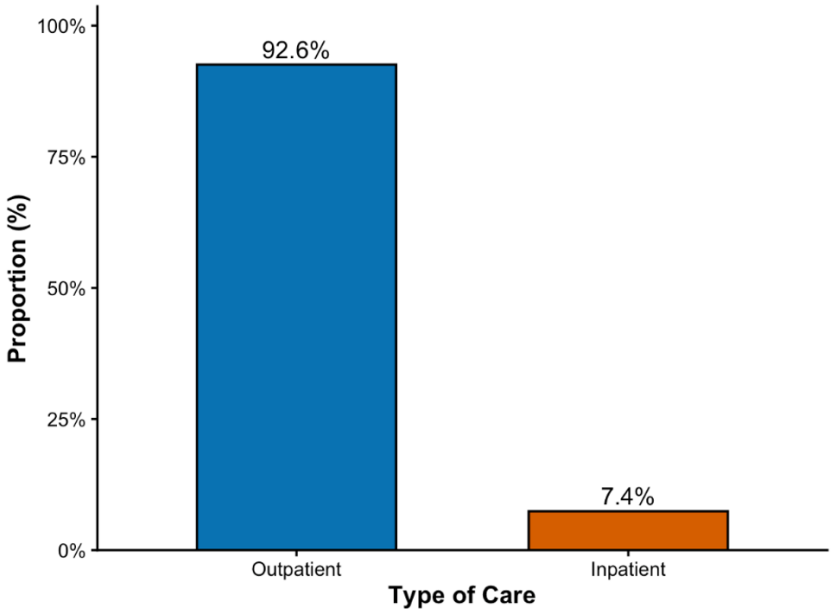

Figure 1. Distribution of breast cancer cases by type of care among insured patients in Indonesia, 2024. Data are derived from the National Health Insurance Sample Data (NHISD) provided by BPJS Kesehatan, covering healthcare services reimbursed from January to December 2024. Case counts represent weighted estimates based on individual sampling weights (expansion factors) to account for the representativeness of the NHISD sample by sex, age group, and insurance enrollment segment. Outpatient care refers to all breast cancer–related services delivered without overnight hospitalization, including chemotherapy administration, radiotherapy, diagnostic procedures, and follow-up consultations. Inpatient care refers to services requiring hospital admission, classified by disease severity as mild, moderate, or severe based on Indonesian Case-Based Group (INA-CBG) codes. Percentages represent the proportion of weighted case counts relative to the total study population (n = 51,165)

Treatment characteristics

A total of 1,409,482 breast cancer–related healthcare visits were recorded in the NHISD database (Table 3). Follow-up examinations accounted for the largest proportion of healthcare utilization, representing 30.60% (n = 431,040 visits) of all recorded encounters. Chemotherapy was the second most frequently utilized treatment category, comprising 20.00% (n = 281,222 visits), followed by surgery at 13.90% (n = 196,463 visits), other procedures at 13.6% (n = 191,041 visits), and diagnostic services at 12.40% (n = 174,413 visits). Radiotherapy contributed 7.70% (n = 108,991 visits) of total healthcare utilization, while rehabilitation services represented the smallest proportion at 1.90% (n = 26,312 visits). Overall, these findings indicate that breast cancer management in Indonesia during 2024 was characterized by frequent follow-up monitoring and substantial utilization of chemotherapy and procedural interventions, reflecting the intensive and continuous nature of cancer care within the national health insurance system.

Cost analysis

Table 4 summarizes the total direct medical cost of breast cancer care reimbursed by BPJS Kesehatan in 2024 amounted to IDR 834.11 billion**.** The reported total costs represent comprehensive direct medical expenditures, which include chemotherapy, diagnostic services, follow-up examinations, radiotherapy, and surgical care. Follow-up examination costs were therefore incorporated into the overall treatment costs and additionally presented separately to illustrate the relative contribution of each cost component to the total economic burden.

Chemotherapy accounted for the largest share of total expenditure (42%), followed by surgery (21%), radiotherapy (14%), follow-up examinations (14%), and diagnostic services (9%). At the patient level, the median total cost per patient was IDR 10.70 million (IQR: 3.90-22.63 million), while the mean cost reached IDR 16.82 million (SD: IDR 17.11 million), indicating substantial cost variability.

Table 3. Treatment characteristics of breast cancer patients

Categories	Number of visits (n=1,409,482)	Percentage (%)
Chemotherapy	281,222	20.00
Diagnostic	174,413	12.40
Follow-up examination	431,040	30.60
Other procedures	191,041	13.60
Surgery	196,463	13.90
Radiotherapy	108,991	7.70
Rehabilitation	26,312	1.90

Note: Visit counts represent the total number of breast cancer–related healthcare encounters recorded in the NHISD database during 2024 and may include multiple visits from the same patient. Frequencies presented in this table are weighted estimates generated using NHISD sampling weights to reflect nationally representative utilization patterns under the JKN system.

Table 4. Direct medical cost components of breast cancer care

Cost components	Median (IQR: Q1-Q3) (IDR millions)	Total cost (IDR millions)	Percentage
Chemotherapy	8.49 (4.32-17.76)	347,880.00	42%
Diagnostic	1.27 (0.59-2.22)	77,910.00	9%
Follow-up examination	1.43 (0.61-3.23)	120,240.00	14%
Radiotherapy	2.42 (1.92-3.12)	115,420.00	14%
Surgery	3.14 (0.40-7.2)	172,660.00	21%
Grand total	**10.70** (3.90-22.63)	**834,110.00**	**100.00**

Note: All costs are in millions of Indonesian Rupiah (IDR; 2024 prices). Medians represent per-patient annual direct medical costs. IQR is reported as Q1-Q3. Total cost represents aggregate 2024 BPJS Kesehatan reimbursement for all eligible breast cancer–related claims.

Among individual cost components, chemotherapy incurred the highest median per-patient cost (IDR 8.49 million), whereas surgery exhibited the greatest dispersion, reflected by a high mean cost and wide standard deviation. Overall, these findings highlight chemotherapy and surgical care as the principal cost drivers of breast cancer management within the national health insurance system.

Further stratification by care setting and disease severity (Table 5) demonstrates that inpatient services accounted for a substantial proportion of direct medical costs, with expenditures increasing markedly with severity. Patients with severe inpatient disease incurred the highest per-patient costs, with a median total cost of IDR 62.34 million (IQR: 47.52-89.43 million) and a total expenditure of IDR 67.84 billion, largely driven by chemotherapy. In contrast, mild and moderate inpatient cases had lower median costs per patient (IDR 28.91 million and IDR 25.95 million, respectively), yet together contributed more than IDR 304.64 billion to overall inpatient spending, primarily due to surgical and chemotherapy services.

Outpatient care represented the largest share of total expenditure (IDR 461.69 billion), despite substantially lower median per-patient costs (IDR 3.49 million; (IQR: 2.04-7.93 million)), reflecting the high volume of outpatient encounters. Across all care settings and severity levels, chemotherapy consistently emerged as the dominant cost component, followed by surgery in inpatient care and radiotherapy in outpatient care, underscoring the major cost drivers of breast cancer management within the national health insurance system.

Building on the severity-based cost distribution, Table 6 further disaggregates direct medical expenditures by type of care. Overall, outpatient services contributed the largest share of total breast cancer–related costs (IDR 461.69 billion), exceeding inpatient expenditures (IDR 372.42 billion), largely due to the high volume of outpatient encounters. However, the per-patient economic burden was substantially higher in inpatient care, with a median cost of IDR 31.12 million (IQR: 28.73-45.09 million) compared with IDR 3.49 million (IQR: 2.71-5.66 million) for outpatient care.

Table 5. Disease severity–specific direct medical costs of breast cancer

Cost components	Median (IQR: Q1-Q3) (IDR millions)	Total cost (IDR millions)
Mild (inpatient mild severity)	**28.91 (26.78-54.31)**	**215,540.00**
Chemotherapy	2.68 (1.59-4.43)	52,920.00
Diagnostic	4.65 (3.02-6.78)	5,680.00
Follow-up examination	3.37 (2.43-7.02)	20,290.00
Radiotherapy	11.35 (9.57-15.64)	68.08
Surgery	6.86 (4.21-9.30)	136,560.00
Moderate (inpatient moderate severity)	**25.95** (23.49-47.06)	**89,100.00**
Chemotherapy	5.03 (3.21-8.06)	72,490.00
Diagnostic	6.20 (3.84-10.27)	390.83
Follow-up examination	7.06 (5.43-11.76)	2,770.00
Radiotherapy	—	—
Surgery	7.66 (4.39-12.06)	13,450.00
Outpatient	**3.49** (2.04-7.93)	**461,690.00**
Chemotherapy	1.48 (0.74-3.65)	161,890.00
Diagnostic	0.45 (0.31-2.96)	68,940.00
Follow-up examination	0.21 (0.13-2.67)	95,740.00
Radiotherapy	1.14 (0.57-2.74)	115,350.00
Surgery	0.21 (0.18-1.69)	19,750.00
Severe (inpatient severe severity)	**62.34** (47.52-89.43)	**67,840.00**
Chemotherapy	12.86 (10.29-16.82)	60,590.00
Diagnostic	16.33 (14.21-20.11)	2,880.00
Follow-up examination	12.86 (10.45-15.42)	1,460.00
Radiotherapy	—	—
Surgery	20.30 (18.31-24.76)	2,900.00
Grand total	**120.71** (109.57-138.32)	**834,110.00**

Note: All costs are in millions of Indonesian Rupiah (IDR); medians represent per-patient annual direct medical costs. IQR is reported as Q1–Q3; (—) indicates that this cost component was not recorded for this severity group in the NHISD database. Total cost is the aggregate 2024 BPJS Kesehatan reimbursement for all eligible breast cancer–related claims.

Consistent with findings across severity levels, chemotherapy emerged as the dominant cost component in both care settings, accounting for IDR 186.02 billions of inpatient costs and IDR 161.89 billions of outpatient costs. In inpatient care, chemotherapy and surgery jointly represented the majority of expenditures, reflecting the higher treatment intensity and complexity associated with hospitalization. Conversely, outpatient spending was primarily driven by chemotherapy, radiotherapy, and follow-up examinations, underscoring the central role of ambulatory treatment and ongoing disease monitoring in breast cancer management. Collectively, these results demonstrate that while outpatient care dominates total expenditure, inpatient services impose a markedly higher cost per patient, reinforcing the complementary insights provided by the severity-based cost analysis.

Table 7 presents the comparison of median direct medical costs across inpatient severity levels using outpatient care as the reference category. Overall, the findings demonstrate a consistent pattern of higher median costs among inpatient cases, particularly among patients with more advanced severity levels. Across most cost categories, the magnitude of the

Table 6. Direct medical costs of breast cancer by type of care and cost component, Indonesia

Cost components	Median (IQR: Q1-Q3) (IDR millions)	Total cost (IDR millions)
Inpatient	**31.12** (28.73-45.09)	**372,420.00**
Chemotherapy	4.30 (2.33-6.74)	186,020.00
Diagnostic	4.99 (2.40-7.31)	8,950.00
Follow-up examination	3.60 (2.49-6.58)	24,510.00
Radiotherapy	11.35 (9.34-15.40)	68.08
Surgery	6.88 (5.76-8.23)	152,910.00
Outpatient	**3.49** (2.71-5.66)	**461,690.00**
Chemotherapy	1.48 (0.78-3.64)	161,890.00
Diagnostic	0.45 (0.18-3.89)	68,940.00
Follow-up examination	0.21 (0.11-2.64)	95,740.00
Radiotherapy	1.14 (0.78-4.30)	115,350.00
Surgery	0.21 (0.13-3.76)	19,750.00
Grand total	**34.61** (30.59-57.41)	**834,110.00**

Note: All costs are in millions of Indonesian Rupiah (IDR); medians represent per-patient annual direct medical costs from claims, while the total cost is the aggregate 2024 BPJS Kesehatan reimbursement for all eligible breast cancer–related claims.

median difference increased from mild to moderate and severe inpatient severity, indicating a progressive escalation in resource utilization with increasing disease severity.

For chemotherapy costs, a clear and statistically significant severity gradient was observed. Compared with outpatient care, median chemotherapy costs were significantly higher in mild inpatient cases (median difference: IDR 1.11 million, 95% CI: IDR 1.02–1.19 million, p<0.001), moderate cases (median difference: IDR 3.47 million, 95% CI: IDR 3.28–3.66 million, p<0.001), and severe cases (median difference: IDR 10.63 million, 95% CI: IDR 9.11–12.14 million, p<0.001). This pattern suggests that chemotherapy-related expenditures increase substantially with inpatient severity, likely reflecting more intensive or repeated systemic treatment among clinically complex patients.

A similar pattern was observed for radiotherapy costs, although the distribution appeared less uniform across severity groups. Median radiotherapy costs were significantly higher among mild (median difference: IDR 10.20 million, p=0.042) and moderate inpatient cases (median difference: IDR 20.23 million, p=0.030) compared with outpatient care. Severe inpatient cases also showed a statistically significant difference (p<0.001), although the estimate appeared more variable, suggesting greater heterogeneity in radiotherapy utilization among patients with severe disease. Overall, these findings indicate that radiotherapy contributes substantially to treatment costs in both inpatient and outpatient settings, with particularly elevated costs among hospitalized patients requiring more intensive care.

For diagnostic costs, inpatient cases also showed higher median expenditures than outpatient care. The differences were statistically significant for mild inpatient severity (median difference: IDR 4.13 million, 95% CI: IDR 3.24–5.02 million, p<0.001) and moderate severity (median difference: IDR 5.69 million, 95% CI: IDR 0.31–11.07 million, p=0.038). In contrast, although severe inpatient cases had the highest median diagnostic cost (IDR 12.10 million), the difference relative to outpatient care was not statistically significant (p=0.171), likely due to greater variability in diagnostic resource use among these patients. This suggests that while diagnostic intensity generally increases with severity, cost patterns may become less predictable in the most severe cases.

Surgical costs showed one of the most pronounced increases across severity levels. Compared with outpatient care, median surgical costs were significantly higher in mild inpatient cases (median difference: IDR 6.54 million, p<0.001), moderate cases (median difference: IDR 10.54 million, p<0.001), and severe cases (median difference: IDR 15.83 million, p=0.013).

Table 7. Comparison of median direct medical costs by cost category and disease severity relative to outpatient care

Cost category	Median	Median difference	p value	95% CI
Chemotherapy cost				
Outpatient (reference)	—	—	—	—
Mild (inpatient mild severity)	2.61	1.11	**<0.001**	1.02 – 1.19
Moderate (inpatient moderate severity)	4.98	3.47	**<0.001**	3.28 – 3.66
Severe (inpatient severe severity)	12.13	10.63	**<0.001**	9.11 – 12.14
Radiotherapy				
Outpatient (reference)	—	—	—	—
Mild (inpatient mild severity)	11.35	10.20	0.042	0.39 – 20.01
Moderate (inpatient moderate severity)	21.38	20.23	0.030	1.97 – 38.50
Severe (inpatient severe severity)	6.45	3.46	**<0.001**	–6.14 – 6.90
Diagnostic				
Outpatient (reference)	—	—	—	—
Mild (inpatient mild severity)	4.73	4.13	**<0.001**	3.24 – 5.02
Moderate (inpatient moderate severity)	6.20	5.69	0.038	0.31 – 11.07
Severe (inpatient severe severity)	12.10	7.36	0.171	-3.17 – 17.89
Surgery				
Outpatient (reference)	-	-	-	-
Mild (inpatient mild severity)	6.75	6.54	**<0.001**	6.39 – 6.69
Moderate (inpatient moderate severity)	10.75	10.54	**<0.001**	5.52 – 15.56
Severe (inpatient severe severity)	18.17	15.83	0.013	3.32 – 28.34
Follow-up examination				
Outpatient (reference)	—	—	—	—
Mild (inpatient mild severity)	5.83	5.44	**<0.001**	3.89 – 6.99
Moderate (inpatient moderate severity)	12.86	12.66	**0.001**	5.03 – 20.28
Severe (inpatient severe severity)	11.35	10.20	0.044	0.30 – 20.11
Annual direct medical cost				
Outpatient (reference)	—	—	—	—
Mild (inpatient mild severity)	3.92	3.33	**<0.001**	3.13 – 3.58
Moderate (inpatient moderate severity)	5.17	4.75	**<0.001**	4.69 – 4.79
Severe (inpatient severe severity)	12.26	11.75	**<0.001**	11.07 – 12.64

Note: All costs are in millions of Indonesian Rupiah (IDR; 2024 prices). The outpatient group served as the reference category for all comparisons. p values were derived from Wilcoxon rank-sum tests; 95% CIs were estimated using non-parametric bootstrap resampling with 1,000 iterations. (—) indicates reference category.

These results indicate that surgery becomes increasingly resource-intensive as disease severity progresses, likely reflecting more extensive operative procedures and perioperative management in hospitalized patients.

A comparable trend was seen for follow-up examination costs, where all inpatient severity groups incurred significantly higher median costs than outpatient care. Median differences were IDR 5.44 million for mild severity ($p<0.001$), IDR 12.66 million for moderate severity ($p=0.001$), and IDR 10.20 million for severe severity ($p=0.044$). These findings suggest that inpatient cases require more intensive clinical monitoring and repeated follow-up assessments, particularly among patients with moderate and severe disease.

When considering annual direct medical costs overall, all inpatient severity groups had significantly higher median costs than outpatient care. The median annual cost difference was IDR 3.33 million for mild inpatient severity (95% CI: IDR 3.13–3.58 million, $p<0.001$), IDR 4.75 million for moderate severity (95% CI: IDR 4.69–4.79 million, $p<0.001$), and IDR 11.75 million for severe severity (95% CI: IDR 11.07–12.64 million, $p<0.001$). Taken together, these findings confirm a strong and statistically significant association between disease severity, inpatient care, and higher direct medical costs, with the most pronounced cost differentials observed among patients with severe disease.

Discussion

This study provides updated and nationally representative evidence on the economic burden of breast cancer in Indonesia in 2024 from the healthcare payer perspective. Using BPJS Kesehatan claims data, we demonstrated that breast cancer imposed a substantial direct medical cost burden on the national health insurance system, reaching approximately IDR 834.11 billion annually. Expenditures were strongly influenced by disease severity and type of care. These findings contribute to the still limited cost-of-illness evidence from low- and middle-income countries (LMICs) and are particularly relevant in the context of expanding universal health coverage in Indonesia [12,16,17].

Chemotherapy emerged as the largest contributor to total direct medical costs, accounting for more than 40% of overall expenditure. In the present study, chemotherapy also showed the most consistent and pronounced increase across severity levels, suggesting that disease progression is closely linked to escalating systemic treatment needs and associated reimbursement costs. This finding is consistent with previous cost-of-illness studies from LMICs and Asian settings, which have reported systemic therapy as the principal cost driver in breast cancer management, especially in advanced disease requiring prolonged treatment cycles [17]. As access to anticancer medicines expands under national insurance schemes, chemotherapy-related expenditures are expected to rise further, underscoring the importance of cost containment strategies and value-based treatment selection [18,19].

Surgical care represented the second-largest cost component, particularly among inpatient cases. This pattern aligns with prior evidence indicating that patients diagnosed at later stages often require more extensive surgical procedures, longer hospital stays, and greater perioperative resource utilization [20,21]. In Southeast Asian contexts, inpatient surgical management has consistently been associated with substantially higher per-patient costs compared with early-stage, outpatient-oriented care [22]. The prominent contribution of surgical costs observed in this study suggests that late-stage presentation remains common despite increased coverage under Jaminan Kesehatan Nasional (JKN). This interpretation is further supported by the significantly higher median surgical costs observed in inpatient groups relative to outpatient care.

Although outpatient care accounted for the largest share of total expenditure due to the high volume of ambulatory encounters, inpatient care was associated with markedly higher per-patient costs, reflecting differences in treatment intensity and case complexity [3,23]. Outpatient expenditure was primarily driven by the very high volume of healthcare encounters, including chemotherapy administration, radiotherapy sessions, routine monitoring, and follow-up examinations. In contrast, inpatient care concentrated resource utilization among a smaller number of patients with more severe disease and more complex treatment needs [3,23], yet generated nearly comparable expenditures, indicating a substantially higher cost intensity among hospitalized breast cancer cases. This pattern has been reported in previous insurance-based analyses and is consistent with the well-established relationship between inpatient admission, advanced disease, and elevated per-episode costs [3,23]. Factors likely contributing to this cost intensity include

major surgical procedures, prolonged hospitalization, multidisciplinary treatment, supportive care, and management of treatment-related complications, as well as accommodation and monitoring costs not typically incurred in outpatient settings.

Severity-stratified analyses revealed a clear and statistically significant cost gradient associated with disease progression. Median annual direct medical costs increased substantially from outpatient care to mild, moderate, and severe inpatient disease, with severe cases incurring the highest costs across nearly all cost categories. Chemotherapy, surgery, and follow-up examinations showed the largest and most consistent cost differences between inpatients severity groups and outpatient care, with the most pronounced differentials observed among patients with severe disease. These severity-related cost gradients are consistent with international studies documenting that advanced-stage breast cancer is associated with substantially higher healthcare expenditures due to multimodal therapy, complication management, and intensive monitoring [23–26], and allign with previous national evidence showing that breast cancer in Indonesia is frequently managed at more severe levels of disease [3].

The predominance of severe inpatient cases observed in this study may indirectly reflect the persistent challenge of late-stage breast cancer diagnosis in Indonesia. Although clinical staging information was not available in the NHISD database, severe INA-CBG classifications are likely associated with more advanced disease requiring intensive treatment, prolonged hospitalization, multimodal therapy, and supportive care. Previous studies in Indonesia have consistently reported that a substantial proportion of breast cancer patients are diagnosed at advanced stages due to delayed health-seeking behavior, limited screening uptake, referral delays, and unequal access to oncology services across regions [11,27]. Similar patterns have also been reported in other developing countries and LMICs, where advanced-stage breast cancer contributes disproportionately to healthcare expenditures because patients frequently require more complex and resource-intensive management [28]. Furthermore, more than half of patients in this study were treated under Class III inpatient coverage, which predominantly represents lower-income and government-subsidized JKN beneficiaries. This finding suggests that economically vulnerable populations may experience a substantial burden of severe disease and high-cost care. Although socioeconomic disparities were not directly assessed in this study, the predominance of Class III utilization highlights the importance of improving equitable access to early detection, timely diagnosis, and cancer treatment services among financially vulnerable populations within the JKN system.

The observed differences in follow-up examination and diagnostic costs also merit attention. Inpatient cases, particularly those with moderate and severe disease, showed substantially higher median follow-up and diagnostic expenditures than outpatient care, suggesting a greater need for repeated clinical review, laboratory testing, imaging, and treatment monitoring. These findings are consistent with prior evidence indicating that the economic burden of advanced breast cancer extends well beyond active treatment, encompassing substantial utilization of supportive and surveillance-related healthcare services [26, 29]. Patients with advanced disease frequently require repeated reassessment, multidisciplinary management, and more intensive supportive care, all of which contribute meaningfully to total healthcare costs [18,30]. Although some variability was observed in radiotherapy and diagnostic comparisons—likely reflecting heterogeneity in treatment pathways and patient-specific clinical indications—the overall pattern remains consistent: progression to more severe disease is associated with broader and more intensive healthcare utilization, extending beyond therapeutic interventions to include a substantial burden of diagnostic, monitoring, and supportive services.

From a policy perspective, these results highlight the economic value of early detection and timely treatment, and provide strong economic justification for strengthening early detection programs within JKN. Prior studies in Indonesia and comparable LMICs have shown that delayed diagnosis remains prevalent, driven by limited screening uptake, regional disparities in diagnostic capacity, and referral delays [11,27,28,31,32]. International evidence suggests that shifting diagnosis toward earlier stages can substantially reduce inpatient utilization and high-cost interventions, ultimately improving both clinical outcomes and financial sustainability [24,33,34]. Specific policy priorities informed by these findings include improved referral coordination, expanded access to diagnostic work-up, earlier initiation of definitive treatment, and the integration of cost-

effectiveness evidence into benefit design and health technology assessment processes within the JKN framework.

This study benefits from the use of a large, nationally representative claims database and a bottom-up costing approach that captures detailed reimbursement data across care settings and severity levels. However, several limitations should be acknowledged. The analysis was restricted to direct medical costs reimbursed by BPJS Kesehatan and did not include indirect costs, non-medical expenditures, or out-of-pocket payments, which may underestimate the full societal burden of breast cancer. Disease severity was inferred from INA-CBG codes rather than clinical staging, which may introduce misclassification and limits the direct comparability of severity categories with clinical stage classifications used in international studies. In addition, the cross-sectional design limits the assessment of long-term cost trajectories across the disease course, including survivorship, recurrence, and end-of-life care. Future longitudinal studies using linked clinical and claims data would be valuable to characterize the full economic burden of breast cancer across the care continuum in Indonesia.

Conclusion

Breast cancer imposes a considerable financial burden on Indonesia's national health insurance system, with costs predominantly driven by chemotherapy, surgical care, and advanced disease severity. While outpatient care contributes most to total expenditure due to high service volume, inpatient care—particularly among patients with severe disease—results in substantially higher per-patient costs. These findings provide robust economic evidence to support policies prioritizing early detection, timely diagnosis, and efficient outpatient-based management, and underscore the importance of integrating cost-of-illness evidence into health technology assessment and benefit design processes within the JKN framework, to ensure the long-term sustainability of cancer care financing in Indonesia.

Data availability statement

The data underlying this article were provided by BPJS Kesehatan by permission. Data will be shared on request to the corresponding author with permission of BPJS Kesehatan.

Funding

None.

Declaration of interest

All authors declare that they have no conflicts of interest.

Author contributions

SMK: conceptualization, methodology, validation, formal analysis, investigation, resources, data curation, writing-original draft, writing-review & editing, visualization, project administration. DS: investigation, writing-review & editing.

Received: April 23, 2026
Revised: May 21, 2026
Accepted: May 22, 2026
Published: May 29, 2026

References

1. Bray F, Laversanne M, Sung H, Ferlay J, Siegel RL, Soerjomataram I, et al. Global cancer statistics 2022: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin. 2024;74(3):229–263. https://doi.org/10.3322/caac.21834
2. Freihat O, Sipos D, Kovacs A. Global burden and projections of breast cancer incidence and mortality to 2050: a comprehensive analysis of GLOBOCAN data. Front Public Health. 2025;13:1622954. https://doi.org/10.3389/fpubh.2025.1622954
3. Khoirunnisa SM, Setiawan D, Postma MJ, de Jong LA. Trends in breast cancer in Indonesia from 2017 to 2020: A national-level analysis by age and disease severity. Cancer Treat Res Commun. 2025;45. https://doi.org/10.1016/j.ctarc.2025.101000
4. Agustina R, Dartanto T, Sitompul R, Susiloretni KA, Suparmi, Achadi EL, et al. Universal health coverage in Indonesia: concept, progress, and challenges. Lancet. 2019;393(10166):75–102. https://doi.org/10.1016/S0140-6736(18)31647-7
5. Anwar SL, Tampubolon G, Van Hemelrijck M, Hutajulu SH, Watkins J, Wulaningsih W. Determinants of cancer screening awareness and participation among Indonesian women. BMC Cancer. 2018;18(1). https://doi.org/10.1186/s12885-018-4125-z
6. Solikhah S, Lianawati L, Matahari R, Rejeki DSS. Determinants of Breast Cancer Screening Practice among Women in Indonesia: A Nationwide Study. Asian Pac J Cancer Prev. 2021;22(5):1435. https://doi.org/10.31557/apjcp.2021.22.5.1435

7. Pangestu S, Harjanti EP, Pertiwi IH, Rencz F, Nurdiyanto FA. Financial Toxicity Experiences of Patients With Cancer in Indonesia: An Interpretive Phenomenological Analysis. Value Health Reg Issues. 2024;41:25-31. https://doi.org/10.1016/j.vhri.2023.11.007
8. Gautama W. Breast Cancer in Indonesia in 2022: 30 Years of Marching in Place. Indonesian Journal of Cancer. 2022;16(1):1-2. https://doi.org/10.33371/ijoc.v16i1.920
9. Wahidin M, Febrianti R, Susanty F, Hasanah SR. Twelve Years Implementation of Cervical and Breast Cancer Screening Program in Indonesia. Asian Pac J Cancer Prev. 2022;23(3):829. https://doi.org/10.31557/apjcp.2022.23.3.829
10. Iskandarsyah A, de Klerk C, Suardi DR, Soemitro MP, Sadarjoen SS, Passchier J. Psychosocial and cultural reasons for delay in seeking help and nonadherence to treatment in Indonesian women with breast cancer: a qualitative study. Health Psychol. 2014;33(3):214-221. https://doi.org/10.1037/a0031060
11. Hutajulu SH, Prabandari YS, Bintoro BS, Wiranata JA, Widiastuti M, Suryani ND, et al. Delays in the presentation and diagnosis of women with breast cancer in Yogyakarta, Indonesia: A retrospective observational study. PLoS One. 2022;17(1). https://doi.org/10.1371/journal.pone.0262468
12. Gondhowiardjo S, Christina N, Ganapati NPD, Hawariy S, Radityamurti F, Jayalie VF, et al. Five-Year Cancer Epidemiology at the National Referral Hospital: Hospital-Based Cancer Registry Data in Indonesia. JCO Glob Oncol. 2021;7(7):190-203. https://doi.org/10.1200/go.20.00155
13. Palu M, Maidin A, Sudirman I, Nurdin A. The Total Economic Burden of Breast Cancer in Makassar South Sulawesi, Indonesia. International journal of engineering research and technology. 2013;Vol 2(9):200-210 https://doi.org/10.17577/ijertv2is90149
14. Ng B, Puspitaningtyas H, Wiranata JA, Hutajulu SH, Widodo I, Anggorowati N, et al. Breast cancer incidence in Yogyakarta, Indonesia from 2008-2019: A cross-sectional study using trend analysis and geographical information system. PLoS One. 2023;18(7). https://doi.org/10.1371/journal.pone.0288073
15. Fuad A. Indonesian Social Health Insurance Sample Data are Now Available and Accessible for Research. Pharmacoecon Open. 2019;3(4):643-645. https://doi.org/10.1007/s41669-019-0160-1
16. Fu M, Peng Z, Wu M, Lv D, Li Y, Lyu S. Current and future burden of breast cancer in Asia: A GLOBOCAN data analysis for 2022 and 2050. The Breast. 2025;79:103835. https://doi.org/10.1016/j.breast.2024.103835
17. Yeong SW, Lee SW, Ong SC. Cost of illness of breast cancer in low- and middle-income countries: a systematic review. Health Econ Rev. 2024;14(1):56. https://doi.org/10.1186/s13561-024-00536-0
18. Vondeling GT, Menezes GL, Dvortsin EP, Jansman FGA, Konings IR, Postma MJ, et al. Burden of early, advanced and metastatic breast cancer in The Netherlands. BMC Cancer. 2018;18(1):1-11. https://doi.org/10.1186/s12885-018-4158-3
19. Sagar B, Lin YS, Castel LD. Cost drivers for breast, lung, and colorectal cancer care in a commercially insured population over a 6-month episode: an economic analysis from a health plan perspective. J Med Econ. 2017;20(10):1018-1023. https://doi.org/10.1080/13696998.2017.1339353
20. Blumen H, Fitch K, Polkus V. Comparison of treatment costs for breast cancer, by tumor stage and type of service. Am Health Drug Benefits. 2016;9(1):23–32.
21. Shahjalal M, Mosharaf MP, Dahal PK, Hoque ME, Mahumud RA. Cancer driven direct medical costs in Bangladesh: Evidence from patient perspective. J Cancer Policy. 2025;43:100565. https://doi.org/10.1016/j.jcpo.2025.100565
22. Thu Ngan T, Van Minh H, Donnelly M. Financial toxicity due to breast cancer treatment in low- and middle-income countries: evidence from Vietnam. https://doi.org/10.1007/s00520-021-06210-z
23. Mittmann N, Seung SJ, Ante Z, Liu N, Yong JH, Yusuf A, et al. Updated breast cancer costs for women by disease stage and phase of care using population-based databases. Health Rep. 2024;35(11):3-11. doi:10.25318/82-003-x202401100001-eng
24. Ratri DMN, Fitriyah AA, Mawaddah MHF, Suprapti B, Romadhon PZ, Samirah. Analysis of cost of illness and diagnosis-related group payment system in breast cancer patients with chemotherapy in Indonesia. Pharmacy Education. 2024;24(3):147-152. https://doi.org/10.46542/pe.2024.243.147152
25. Alefan Q, Saadeh A, Yaghan RJ. Direct Medical Costs for Stage-Specific Breast Cancer: A Retrospective Analysis. Breast Cancer Manag. 2020;9(1):33. https://doi.org/10.2217/bmt-2019-0014
26. Gąska I, Czerw A, Pajewska M, Partyka O, Deptała A, Badowska-Kozakiewicz A, et al. The Cost of Breast Cancer: Economic and Social Perspective. Cancers 2025, Vol 17, Page 3012. 2025;17(18):3012. https://doi.org/10.3390/cancers17183012
27. Setyawan IB, Kurnia D, Setiaji K, Anwar SL, Purwanto DJ, Azhar Y, et al. Sociodemographic disparities associated with advanced stages and distant metastatic breast cancers at diagnosis in Indonesia: a cross-sectional study. Annals of Medicine and Surgery. 2023;85(9):4211. https://doi.org/10.1097/MS9.0000000000001030
28. Sotiriou C, Pusztai L. Breast cancer characteristics in low- and middle-income countries: An umbrella review. Cancer Epidemiol. 2025;96(8):102797. https://doi.org/10.1056/NEJMra0801289
29. Teli BD, Behzadifar M, Beiranvand M, Rezapour A, Ehsanzadeh SJ, Azari S, et al. The economic burden of breast cancer in western Iran: a cross-sectional cost-of-illness study. Journal of Health, Population and Nutrition 2025 44:1. 2025;44(1):16-. https://doi.org/10.1186/s41043-025-00738-0
30. Alghamdi A, Balkhi B, Alqahtani S, Almotairi H. The Economic Burden Associated with the Management of Different Stages of Breast Cancer: A Retrospective

Cost of Illness Analysis in Saudi Arabia. Healthcare. 2021;9(7):907. https://doi.org/10.3390/healthcare9070907

31. Nnaji CA, Ezenwankwo EF, Kuodi P, Walter FM, Moodley J. Timeliness of diagnosis of breast and cervical cancers and associated factors in low-income and middle-income countries: a scoping review. BMJ Open. 2022;12(2):e057685. https://doi.org/10.1136/bmjopen-2021-057685
32. Janatolmakan M, Lashkari M, Lehto RH, Negarandeh R. Factors Associated with Delays in Breast Cancer Diagnosis in Low- and Middle-income Countries: A Scoping Review. Int J Community Based Nurs Midwifery. 2026;14(1):22. doi:10.30476/ijcbnm.2025.104511.2632
33. Albeshan SM, Hossain SZ, Mackey MG, Brennan PC. Can Breast Self-examination and Clinical Breast Examination Along With Increasing Breast Awareness Facilitate Earlier Detection of Breast Cancer in Populations With Advanced Stages at Diagnosis? Clin Breast Cancer. 2020;20(3):194-200. https://doi.org/10.1016/j.clbc.2020.02.001
34. Wharam J, Wallace J, Lu C, et al. Costs after incident breast cancer diagnosis among high-deductible health plan members. J Clin Oncol. 2018 Apr 10;36(11):1121-1127. https://doi.org/10.1200/JCO.2019.37.27_suppl.120