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Cost of Breast Cancer Treatment by Comorbidity in Dubai, the United Arab Emirates: A Retrospective Data Analytical Approach

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ABSTRACT

Objective: Breast cancer is the most common malignancy among women in Dubai, yet the economic burden of its treatment remains understudied. This study aimed to estimate the direct medical costs of breast cancer care in Dubai in 2024 and to examine variations by encounter type, comorbidity burden, and provider setting.

Materials and Methods: A retrospective cross-sectional analysis of insurance claims was conducted for January-December 2024. Breast cancer cases were identified using International Classification of Diseases, 10th revision, clinical modification codes, and comorbidity burden was assessed using the Charlson comorbidity index (CCI). Costs were analyzed by encounter type (outpatient, inpatient, day case) and by provider setting (clinic/center versus hospital). A Tweedie generalized linear model was applied to evaluate the effect of comorbidities and service characteristics on costs.

Results: A total of 8,967 patients (mean age 51.8 years) with 81,248 claims were identified. Outpatient visits constituted 86% of encounters and accounted for 81% of total expenditure (USD 48.7M). Inpatient admissions accounted for 6% of encounters and had the highest mean cost per patient (USD 10,808). The total expenditure was USD 60.0M. Costs increased significantly with comorbidity severity: patients with CCI ≥ 5 incurred 6.4-fold higher costs compared to those without comorbidities ($p < 0.0001$). Hospital-based care increased costs by 16%, and pharmacy claims contributed an additional 31% to expenditures.

Conclusion: Breast cancer treatment in Dubai imposes a substantial economic burden, largely driven by outpatient services, hospital-based care, and medication costs. Comorbidity significantly increases expenditures. These findings highlight the importance of integrated, risk-stratified care pathways and sustainable strategies to optimize resource allocation for breast cancer management in the United Arab Emirates.

Keywords: Treatment cost; breast cancer; comorbidity; Dubai; United Arab Emirates

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KEY POINTS

- Breast cancer is the most common malignancy among women globally and in the United Arab Emirates. While costs have been studied in high-income countries, there is limited evidence on the economic burden in Dubai, particularly with respect to comorbidity burden and healthcare setting.
- This study provides the first comprehensive claims-based cost analysis of breast cancer in Dubai. Outpatient services accounted for most spending, but inpatient admissions and higher Charlson comorbidity index scores substantially increased per-patient costs, with severe comorbidities increasing costs more than sixfold. The findings highlight the importance of risk-stratified integrated care pathways and pharmaceutical cost management. They provide evidence to policymakers and insurers in Dubai to support the design of sustainable oncology financing, the prioritization of outpatient management where feasible, and the implementation of value-based purchasing strategies.

Introduction

Breast cancer is the most frequently diagnosed cancer among women worldwide (1). Nearly one in four cancer diagnoses is breast cancer. In 2020, there were 2.3 million global incidents and 685,000 deaths as a result (2). Early detection, screening programs, and newer treatment options have led to improved overall outcomes, particularly in earlier stages of treatment, where these improvements are most evident (3, 4). Despite improved outcomes, breast cancer continues to have a significant clinical and economic impact on healthcare systems globally (5, 6).

The economic burden of breast cancer has been examined thoroughly in high-income countries, where direct medical costs are estimated to be in the billions and are highly influenced by stage at diagnosis, comorbidity burden, age cohort, and type of services utilized (7-9). Economic evaluations are instrumental in guiding healthcare policy decisions, promoting equitable access to care, and ensuring the sustainability of breast cancer care (5). In general, inpatient admissions and targeted therapy have been repeatedly examined as major cost drivers, although the age cohorts demonstrate different cost distributions due to comorbidity profiles and treatment strategies (10-12). In particular, comorbidities significantly increase the economic burden of breast cancer treatment, resulting in higher healthcare costs for patients (13). For instance, researchers have shown that after adjusting for comorbid conditions, the annual difference in total healthcare cost for recently diagnosed breast cancer patients can be substantial, reaching tens of thousands of dollars per patient (14).

Across the Middle East and North Africa, breast cancer accounts for a considerable proportion of cancer diagnoses among females, often occurring at younger ages and at more advanced stages than in Western populations (15, 16). Specifically, in the United Arab Emirates (UAE), breast cancer is the most common malignancy among women, accounting for approximately 38% of all cancers in women (17).

Some published studies on the incidence and treatment modalities of breast cancer can be found in the UAE (18-20). However, literature detailing the economic burden of breast cancer on the healthcare systems in Dubai, UAE, regarding service

type, comorbidity burden, and age cohort cannot be found. This knowledge gap limits the ability of health policymakers and private-sector insurers to understand the economic burden of breast cancer and to develop financing models that are sustainable and that effectively allocate resources within Dubai's health care system.

In our efforts to fill this gap, the present study utilized retrospective claims data from Dubai to estimate the direct medical costs of breast cancer for 2024. Costs were examined by type of service (outpatient, day-case, and inpatient care) and by comorbidity, assessed using the Charlson comorbidity index (CCI). The results will provide policymakers, insurers, and healthcare providers with important information regarding the economic burden of breast cancer in Dubai, and will contribute to evidence-based planning and cost-effective care delivery.

Materials and Methods

Study Design

A cross-sectional retrospective study was conducted using eClaimLink, the electronic platform that records all claim transactions under Dubai-based health insurance policies. This system contains information on the services utilized, the type of healthcare facility where services were delivered, and the associated costs.

All claims related to breast cancer patients, identified by International Classification of Diseases 10th revision (ICD-10), clinical modification codes as the primary diagnosis, were extracted for the period from January to December 2024 using structured query language. The dataset contained information on length of stay (LOS), comorbid conditions, encounter type, services rendered, provider setting (clinic, center, pharmacy, or hospital), net claimed amounts, and demographic variables, such as age. Data on breast cancer stage were not available; therefore, costs could not be analyzed according to disease stage.

Clinical factors, including comorbidities given their influence on medical expenditures, were measured using ICD-10 codes.

Comorbidity burden was assessed using the CCI. The CCI is a validated measure that lists 23 chronic conditions (plus others) and directly indicates those conditions (21). Based on the CCI

score, the severity of comorbidity was categorized into three grades: mild, with CCI scores of 1–2; moderate, with CCI scores of 3–4; and severe, with CCI scores ≥ 5 . The CCI assigned weights to secondary medical conditions, and the score was calculated. The two analytical scenarios were applied: a base scenario in which the CCI was calculated excluding “any malignancy” and “any metastatic solid tumor,” thereby isolating the effect of non-cancer comorbidities. An alternative scenario is when CCI is calculated to include malignancy and metastasis, reflecting the full disease burden when cancer-related conditions are incorporated. This dual specification enabled a comparison of how comorbidity influenced costs, depending on whether cancer itself was included in the index.

Variables

Data on the sociodemographic variables were missing, and only patient age was obtained directly from the records. An outpatient encounter was defined as a visit to a healthcare facility for diagnosis or treatment that did not result in admission. An inpatient encounter was defined as an admission involving at least one overnight stay in the healthcare facility (22). A day-case encounter was defined as an admission in which the patient received care and was discharged on the same day without an overnight stay (23).

The primary outcome was the direct medical cost of breast cancer care, calculated as the net claimed amount submitted to insurers for claims in which breast cancer was recorded only as the primary diagnosis. Independent variables included comorbidity status (CCI score), encounter type (outpatient, day case, inpatient), and provider type (clinic/center, hospital, pharmacy). To define the cost of care related to breast cancer treatment, inpatient visit costs were identified by searching for hospitalizations with ICD-10 codes C50.0–C50.9 (24).

To calculate the average cost, we measured the total annual healthcare spending for each eligible patient on breast cancer-related services, including inpatient admissions, day case and outpatient visits, and medications. All costs were converted from UAE Dirhams (AED) to US\$ using the official US dollar conversion rate (1 US dollar = 3.673 AED).

Statistical Analysis

Data cleaning and analysis were performed using R software. Descriptive statistics were first calculated, including the total cost of breast cancer treatment, the average cost per patient per year, with standard deviation (SD), and the percentage distribution of costs by type of admission. Treatment costs were also stratified by comorbidity status (presence vs. absence of comorbidity).

To account for the highly skewed and zero-inflated pattern of cost data, regression analysis was performed using a Tweedie

generalized linear model (25, 26) with a log link function. The baseline category was defined as patients with no comorbidity (CCI = 0) who were receiving outpatient care at clinics or centers. The model predictors included CCI score, type of encounter (reference: outpatient), provider type (reference: clinic/center), and selected interaction effects between encounter type and provider type. We did not include age in the primary specification because age was inconsistently recorded at the claim level in our data extract, which risked introducing measurement error; furthermore, age and CCI were strongly correlated in our cohort, and exploratory models suggested that including both led to instability and counterintuitive signs without improving model fit. All tests were two-sided, with a p -value < 0.05 indicating statistical significance.

Ethical standards were applied throughout this study as per Dubai Health Authority guidelines and regulations. The Dubai Scientific Research Ethics Committee at the Dubai Health Authority waived ethical approval in such cases because the study used secondary data and did not involve human participants.

Results

A total of 8,967 breast cancer patients were included, with a mean age of 51.8 years (SD: 8.6). The majority (88%) were aged 40–64 years. A total of 81,248 claims were recorded, with 43% of patients having more than five claims. Most encounters were outpatient (86%), followed by day-case (8%) and inpatient admissions (6%). The CCI was 0 in 92% of patients, 1–2 in 0.4%, 3–4 in 5%, and ≥ 5 in 0.1%. Overall, 694 patients had one or more comorbidities (excluding any malignancy or metastasis); the most common were hypertension (98%) and diabetes (77%) (Table 1).

The total direct medical expenditure for breast cancer patients in Dubai in 2024 amounted to USD 60.0 million. Outpatient encounters accounted for the majority of spending (USD 48.7 million; 81%), with a mean annual cost per patient of USD 5,520 (SD: 13,884). Inpatient encounters contributed USD 6.3 million (11%), with an annual mean cost of USD 10,808 (SD: 14,243), representing the highest average cost across encounter types. Day-case encounters accounted for USD 5.0 million (8%), with an annual mean cost of USD 5,696 (SD: 10,662) (Table 2).

In analyses stratified by comorbidity, cost patterns differed depending on how the CCI was specified. Under the base scenario (CCI excluding “any malignancy” and “metastasis”), mean costs were modestly higher in patients with non-cancer comorbidities, and differences were statistically significant for outpatient care (USD 7,604 vs. USD 5,345; $p = 0.0003$) but not for inpatient care (USD 15,906 vs. USD 10,236; $p = 0.283$) or day case encounters (USD 5,097 vs. USD 5,764; $p = 0.514$). In contrast, under the alternative scenario (CCI including “any malignancy” and “metastasis”), the comorbidity group accounted for virtually

Table 1. Summary statistics for breast cancer patients in Dubai, 2024

Variables	Patients	
	n	%
Overall study population	8,967	
Age in years (mean ± SD)	51.8±8.6	
18–39	664	7%
40–64	7,877	88%
65+	427	5%
Categorize by claim count		
Claim count of 1	2,235	25%
2 to 3	1,870	21%
4 to 5	1,034	12%
>5	3,828	43%
Categorize by encounter type		
Outpatient	8,819	86%
Inpatient	585	6%
Day case	880	8%
Baseline risk score-CCI¹		
0	8,273	92%
1–2	652	7%
3–4	37	0.4%
5+	5	0.1%
Comorbidities		
Yes	694	
CVD ²	22	3.2%
Renal disease	31	4%
Rheumatic disease	35	5%
CHF ³	43	6%
Asthma	60	9%
COPD ⁴	71	10%
Diabetes uncomplicated	312	45%
Diabetes complicated	225	32%
Hypertension	683	98%
Metastasis		
Yes	1,325	15%

¹: Charlson comorbidity index; ²: Cardiovascular disease; ³: Congestive heart failure; ⁴: Chronic obstructive pulmonary disease; SD: Standard deviation

all expenditure and exhibited consistently higher mean costs across settings: outpatient (USD 5,895 vs. USD 885; $p < 0.0001$), inpatient (USD 10,928 vs. USD 7,720; $p = 0.0012$), and day case (USD 5,721 vs. USD 4,240; $p = 0.0205$). These findings indicate that when cancer-related disease burden is incorporated into the comorbidity construct, the incremental cost associated with comorbidity becomes substantial and statistically robust

across all encounter types, with the largest absolute difference observed in outpatient care (Table 3).

To examine the role of comorbidity severity, patients were classified into three CCI groups (1–2, 3–4, and ≥ 5) and costs were compared across encounter types under both scenarios (Table 4). The analysis revealed a progressive increase in costs across encounter types in both scenarios, though the strength of association varied. In base scenario, cost tended to rise with higher CCI, but statistical significance was limited particularly for the ≥ 5 group, where small numbers constrained interpretation. In contrast, the alternative scenario demonstrated a clear and statistically robust gradient. Outpatient costs increased from USD 4,215 (CCI: 1–2) to USD 5,823 (CCI: 3–4) and USD 14,000 (CCI ≥ 5 ; $p < 0.005$). Inpatient mean costs followed a similar pattern (USD 10,020 to 8,424 to 13,744; $p = 0.02$ from 3–4 vs. ≥ 5), while day case costs rose from USD 4,913 to USD 3,943 and USD 7,331 respectively ($p = 0.003$ from 3–4 vs. ≥ 5). These findings underscore the substantial cost burden associated with advanced comorbidities when cancer-related conditions are included in the index.

To address the weaker significance in the base scenario and to more precisely estimate the independent effects of comorbidity, we performed multivariable regression (Table 5).

The regression analysis identified several factors with significant multiplicative effects on breast cancer treatment costs (Table 5). When using outpatient at clinic/center with CCI = 0 as the reference, a graded association between non-cancer comorbidity and higher spending was observed.

Compared with CCI = 0, CCI 1–2 was associated with a 16% increase in costs [ratio: 1.16; 95% confidence interval (CI): 1.00–1.34; $p = 0.03$], while CCI 3–4 was directionally higher, but not statistically significant (ratio: 1.46; 95% CI: 0.88–2.44; $p = 0.141$). Patients with CCI ≥ 5 experienced a marked rise—approximately 6.45-fold higher costs (ratio: 6.44; 95% CI: 2.62–15.84; $p < 0.0001$).

Relative to the reference encounter, day case care was associated with a 57% increase in costs (ratio: 1.57; 95% CI: 1.33–1.84; $p < 0.0001$) and inpatient care was associated with nearly a threefold increase (ratio: 2.90; 95% CI: 2.44–3.45; $p < 0.0001$).

By provider setting, care delivered in hospitals was associated with 16% higher costs (ratio: 1.158; 95% CI: 1.030–1.302; $p = 0.014$) and pharmacy claims were associated with 31% higher costs (ratio: 1.311; 95% CI: 1.146–1.499; $p < 0.0001$) compared with clinic/center. The model's baseline mean cost was 3,142 USD (95% CI: 2,830–3,489).

These regression estimates are further visualized in Figure 1, which provides a graphical representation of the multiplicative effects and their confidence intervals.

Table 2. Distribution of breast cancer treatment costs by encounter type in Dubai, 2024

Encounter type	n	Total (USD)	Mean (USD)	SD	%
Outpatient	(8819)	48,683,546	5,520	13,884	81%
Inpatient	(585)	6,322,425	10,808	14,243	11%
Day case	(880)	5,012,297	5,696	10,662	8%

N: Number of breast cancer patients; Mean: Annual mean treatment cost per patient in US dollars (USD); SD: Standard deviation. Percentages represent each encounter type's share of total annual breast cancer treatment expenditure

Table 3. Distribution of breast cancer treatment cost by presence of comorbidity in Dubai, 2024

Base scenario-CCI excludes any malignancy and metastasis									
Encounter type	Comorbidity-no				Comorbidity-yes				p-value
	n	Total (USD)	Mean (USD)	SD	n	Total (USD)	Mean (USD)	SD	
Out-patient	(8,134)	43,475,096	5,345	13,700	(685)	5,208,450	7,604	15,767	0.0003
In-patient	(526)	5,383,943	10,236	6,659	(59)	938,483	15,906	40,148	0.283
Day case	(790)	4,553,610	5,764	10,842	(90)	458,687	5,097	8,956	0.514

Alternative scenario-CCI includes any malignancy and metastasis									
Encounter type	Comorbidity-no				Comorbidity-yes				p-value
	n	Total (USD)	Mean (USD)	SD	n	Total (USD)	Mean (USD)	SD	
Out-patient	(659)	583,370	885	2,816	(8,160)	48,100,176	5,895	14,346	<0.0001
In-patient	(22)	169,837	7,720	3,394	(563)	6,152,589	10,928	14,491	0.0012
Day case	(15)	63,600	4,240	1,889	(865)	4,948,697	5,721	10,750	0.0205

N: Number of breast cancer patients; Mean: Annual mean treatment cost per patient; SD: Standard deviation; CCI: Charlson comorbidity index. The "base scenario" defines comorbidity using CCI scores that exclude "any malignancy" and "metastasis," whereas the "alternative scenario" includes these conditions. p-values correspond to two-sided tests comparing the mean annual treatment costs between patients with and without comorbidity within each encounter type (Statistical significance was defined as $p < 0.05$)

Table 4. Distribution of breast cancer treatment cost according to Charlson's comorbidity index classification

Base scenario-CCI excludes any malignancy and metastasis													
Encounter type	Charlson index 1–2				Charlson index 3–4				Charlson index ≥5				p-value
	n	Total (USD)	Mean (USD)	SD	n	Total (USD)	Mean (USD)	SD	n	Total (USD)	Mean (USD)	SD	
Out-patient	(646)	4,900,559	7,586	15,943	(35)	307,058	8,773	13,100	(4)	833	208	216	0.0005 ^a
In-patient	(54)	529,353	9,803	5,733	(4)	94,347	23,587	7,562	(1)	314,783	314,783	-	0.0328 ^b
Day case	(84)	429,620	5,115	9,168	(5)	27,682	5,536	6,079	(1)	1,384	1,384	-	0.8900 ^{a,c}

Alternative scenario-CCI includes any malignancy and metastasis													
Encounter type	Charlson index 1–2				Charlson index 3–4				Charlson index ≥5				p-value
	n	Total (USD)	Mean (USD)	SD	n	Total (USD)	Mean (USD)	SD	n	Total (USD)	Mean (USD)	SD	
Out-patient	(6385)	26,913,622	4,215	10,178	(448)	2,608,921	5,823	13,116	(1327)	18,577,633	14,000	25,106	<0.005 ^a
In-patient	(380)	3,807,616	10,020	5,500	(32)	269,577	8,424	4,884	(151)	2,075,396	13,744	26,344	0.020 ^d
Day case	(510)	2,505,499	4,913	9,664	(47)	185,331	3,943	5,731	(308)	2,257,867	7,331	12,700	0.003 ^d

N: Number of breast cancer patients; Mean: Annual mean treatment cost per patient; SD: Standard deviation; CCI: Charlson comorbidity index. CCI categories are presented as 1–2, 3–4, and ≥5.

p-value column:

^a: p-value from an overall comparison of mean annual costs across the three CCI categories (1–2, 3–4, ≥5) within the encounter type and scenario.

^b: p-value from a pairwise comparison between CCI 1–2 and CCI 3–4; the CCI ≥5 category ($n < 2$) was excluded from this test.

^c: In rows where CCI ≥5 has $n < 2$, estimates should be interpreted with caution due to sparse data.

^d: p-value from a pairwise comparison between CCI 3–4 and CCI ≥5. (Statistical significance was defined as $p < 0.05$)

Table 5. Generalized linear regression analysis of the predictors of costs of treatment in patients with breast cancer, Dubai

Variable	Cost ratio	95% CI	p-value
Intercept	3142	2830–3489	<0.0001
CCI band (no cancer items)			
CCI band 1–2	1.16	1.00–1.34	0.0373
CCI band 3–4	1.46	0.88–2.44	0.1405
CCI band ≥5	6.44	2.62–15.84	<0.0001
Encounter type			
Day case	1.57	1.33–1.84	<0.0001
Inpatient	2.90	2.45–3.45	<0.0001
Provider type			
Hospital	1.16	1.03–1.30	0.0143
Pharmacy	1.31	1.14–1.49	<0.0001

Cost ratios are exponentiated coefficients from a Tweedie generalized linear model with a log link, where the dependent variable is total annual breast cancer treatment cost (USD). For each categorical predictor, the reported cost ratios compare the listed category with its reference group: CCI = 0 (no comorbidity); outpatient encounter = clinic/center; and provider type = clinic/center. CCI: Charlson comorbidity index, constructed here by excluding “any malignancy” and “metastasis” to isolate non-cancer comorbidity. CI: Confidence interval. The p-values are from two-sided Wald tests of the null hypothesis that the cost ratio equals 1.00 (Statistical significance was defined as $p < 0.05$)

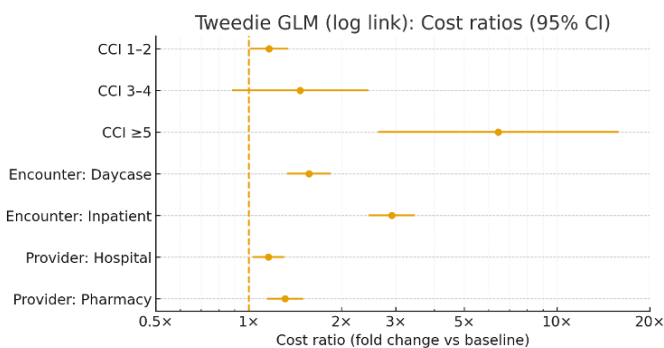


Figure 1. Forest plot of multiplicative effects on breast cancer treatment costs, Dubai, 2024

CCI: Charlson comorbidity index; CI: Confidence interval; GLM: Generalized linear model

Discussion and Conclusion

This research presents what is reportedly among the first comprehensive examinations of breast cancer treatment costs in Dubai, yielding some important findings. The analysis of claims revealed considerable heterogeneity in service use, with almost 50% of patients having incurred more than five claims and one-quarter having incurred only a single claim. This heterogeneity likely reflects variations in treatment intensity, follow-up regimen, and complications related to the disease, and supports the impression that a small proportion of patients account for a large share of the total use of services. Such patterns highlight the value of developing strategies that focus on high-user groups to limit costs, as they will account for the largest share of overall

system utilization costs. Consistent with our findings, researchers from the UAE reported variability in healthcare utilization patterns in Dubai (27) especially during the pandemic. With potentially significant economic implications, cost analyses are important for assessing breast cancer interventions and informing healthcare practice and policy.

According to the present findings, comorbidity significantly affects the cost of treating breast cancer in Dubai. In the base scenario, excluding malignancy and metastasis, the annual mean outpatient cost for patients with comorbidity was USD 7,604 (versus USD 5,345 in patients without comorbidity, $p = 0.0003$), and the mean inpatient and day case costs did not differ between patients with and without comorbidity. When malignancy and metastasis were added to the data from the CCI, the cost difference was significant across all types of encounters. In regression modeling, patients in the highest severity category (CCI ≥5) experienced 6.4 times increased cost compared to patients without comorbidity. The gradient effect illustrates the burden of coexisting cancer and related chronic diseases, which require more complex and intensive management. This is consistent with prior evidence from international studies that have reported that higher CCI scores are associated with increased hospitalizations, longer LOS, and increased overall costs of cancer care (28-31). These findings reinforce the methodological value of systematically including comorbidity in cost-effectiveness studies of breast cancer. Prior studies have shown that cost estimates differ considerably depending on comorbidity specifications, particularly when cancer-related conditions are included and classified using the CCI (32-34).

Overall, these findings provide additional support for viewing comorbidity as more than a clinical predictor of outcomes, rather as an essential contributing factor to an increased economic burden in cancer populations.

The location of care had a significant effect on breast cancer costs in Dubai. Most services were provided in outpatient encounters (86% of all claims, representing USD 48.7 million, or 81% of total costs), with an annual mean cost of care of USD 5,520 per patient. Inpatient admissions comprised only 6% of encounters but accounted for a large share of total costs, with a mean cost per patient of USD 10,808, almost double that of outpatient or day-case care. According to the multivariable regression analysis of costs in this sample, inpatient care was associated with a threefold increase in costs crude ratio (CR): 2.90, 95% CI: 2.45–3.45], and day-case services were associated with a 57% increase in costs (CR: 1.56, 95% CI: 1.33–1.84). When care was provided in a hospital, compared with care in a clinic or featured center, there was a 16% increased cost burden. These patterns were more common among patients with comorbidities, as they were managed in the hospital more often because of greater clinical complexity and a higher need for multidisciplinary interventions; some patients also required monitoring. Previous research has reported a similar finding among breast cancer patients: those with greater CCI scores incur disproportionately high hospital-based healthcare expenditure, largely because of longer inpatient stays, more complications, and an increased need for specialist services (29, 35). On the other hand, patients with low or no comorbidities had more frequent outpatient or ambulatory care visits and significantly lower costs per episode of care. This dual effect—in which comorbidity increases overall economic burden and drives care toward more costly hospital encounters—has also been reflected in other health system assessments (36, 37). This highlights the need for risk-stratified care pathways that incorporate comorbidity status into clinical decision-making, thereby allowing patients with multimorbidity to transition safely into a low-cost outpatient environment without compromising quality of care.

The current results revealed that the cost of medications was a significant driver of overall treatment costs in breast cancer care in Dubai. Pharmacy (medication claims) was independently associated with a 31% increase in overall costs (ratio: 1.31; 95% CI: 1.15–1.49), indicating the substantial contribution of medications to the economic burden of treatment. Patients with higher CCI scores were particularly affected because they were more likely to need antihypertensives, antidiabetics, and cardioprotective drugs to treat chronic conditions such as hypertension, diabetes, and cardiovascular disease, in addition to oncologic therapy. Overall, the combined effect associated with the need for dual treatment resulted in substantial increases in medication costs. These findings align with international evidence demonstrating

that breast cancer patients with multimorbidity require substantially greater volumes of supportive medication addition to standard cancer therapies, such as endocrine treatments and targeted biologics (28-30, 38, 39). This dual challenge of oncology and non-oncology prescriptions not only does it create increased direct medical costs but it also complicates the long-term cost-sharing burden between patients and health systems. These findings highlight the need for holistic strategies in managing pharmaceutical costs that account for interactions among medications prescribed for comorbidities and for cancer management. Incorporating comorbidity status into these approaches may provide an additional targeted method to facilitate access to needed therapies in multimorbid populations with breast cancer.

The greatest strength of this study is the use of a comprehensive claims database, which enables the study to include the fully insured population of breast cancer patients in Dubai. This provides a comprehensive view of the patients' healthcare interactions. Therefore, we can explore the cost drivers in detail through medical encounters, care settings, and comorbidities, and link possible cost drivers within one large, real-world patient group. The dual specification of the CCI is also a strength, as it allows for evaluation of both non-cancer and all-inclusive comorbidity burdens, thereby providing methodological contributions that enhance the interpretability of cost variation. The use of a Tweedie generalized linear model strengthened the analysis by appropriately modeling the skewed distribution of the cost data, thereby improving estimates.

Study Limitations

However, some limitations need to be recognized. The lack of clinical information, including tumor stage, tumor biology, or treatment intent, made it difficult to categorize costs by disease severity or specific treatment pathway. Because diagnostic codes are used to capture the prevailing comorbidities, the true prevalence of these comorbidities may be underestimated. Additionally, some of the age data were missing or incomplete and therefore had to be excluded because the models could not handle an incomplete age variable, and demographic risk factors were therefore not included in some regression models. Our analysis was limited to direct medical costs obtained from insurance claims files and eClaimLink; indirect costs (out-of-pocket costs or expenditures outside of eClaimLink) and non-financial problems (such as loss of productivity and quality of life) were not included in the financial burden analysis. Because the analysis was cross-sectional, we cannot infer causality from the observed associations; it is possible that the associations simply reflect another underlying case mix or provider practice patterns for the patient cohort, which were either not available in the data or not fully captured. In this analysis, may slightly

underestimate breast cancer care costs because costs for which breast cancer was listed as a secondary or tertiary diagnosis were often not considered.

This study provides the first comprehensive assessment of breast cancer treatment costs in Dubai, stratified by comorbidity, offering novel insights into local cost drivers. Outpatient services accounted for most encounters and overall spending; however, inpatient admissions, though less frequent, generated substantially higher per-patient costs. The CCI demonstrated a consistent escalation in costs across care settings, with the greatest impact observed in hospital-based encounters. Medication expenditures also emerged as significant contributors, particularly among patients managing treatments for both cancer and chronic diseases.

These findings underscore the importance of systematically incorporating comorbidity measures into health economic analyses, as they meaningfully alter cost estimates and highlight key drivers of financial burden. By filling a critical evidence gap in the UAE, this study illustrates how localized cost-of-illness data can inform insurance design, service prioritization, and sustainable oncology financing, consistent with other international studies. For policymakers and insurers, these results highlight the need for integrated care models that address comorbidities and expand risk-stratified pathways to safely transition patients toward lower-cost outpatient settings. Strategies to manage pharmaceutical spending should also be implemented, including formulary optimization and value-based purchasing. Future research should extend this work by linking claim-based cost estimates with survival and quality-of-life outcomes, thereby supporting value-based, patient-centered cancer care in Dubai, the UAE.

Ethics

Ethics Committee Approval: The Dubai Scientific Research Ethics Committee at the Dubai Health Authority waived ethical approval in such cases because the study used secondary data and did not involve human participants.

Informed Consent: Informed consent from individuals was not required.

Footnotes

Authorship Contributions

Surgical and Medical Practices: M.M.S., N.A.A., H.M.M.; Concept: M.M.S.; Design: M.M.S.; Data Collection and/or Processing: M.M.S.; Analysis and/or Interpretation: M.M.S., H.M.M.; Literature Search: M.M.S., N.A.A., H.M.M.; Writing: M.M.S., N.A.A., H.M.M.

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