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Healthcare Utilization Patterns in Early-Stage Breast Cancer Taiwanese Patients: A Real World Evidence-based Subtype-specific Study

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Background

- Breast cancer remains the most commonly diagnosed cancer among women in Taiwan, with molecular subtype playing a critical role in prognosis, treatment strategies, and survivorship needs.[1]
- While improvements in human epidermal growth factor receptor 2 (HER2)-targeted and endocrine therapies have markedly enhanced outcomes for many patients, triple-negative breast cancer (TNBC) continues to present clinical and economic challenges due to aggressive disease biology, limited targeted treatment options, and higher risk of recurrence.[2,3]
- Limited research has explored how subtype-driven differences translate into healthcare utilization (HCU) patterns, especially in early-stage disease where survivorship demands and resource use may vary considerably.
- Understanding these patterns is essential in Taiwan's context, where tailored survivorship planning and efficient resource allocation are increasingly important to mitigate the clinical and economic burden of breast cancer.

Objective

This study aimed to examine and compare HCU patterns among early-stage breast cancer subtypes—HER2-positive (HER2+), HER2-negative/hormone receptor-positive (HER2−/HR+), and triple-negative breast cancer (TNBC)—in Taiwan.

Specifically, we sought to:

- Characterize patient demographics and clinical profiles across subtypes.
- Describe HCU trends over a three-year follow-up period, including outpatient visits, hospitalizations, and emergency room (ER) visits.
- Identify factors associated with increased healthcare utilization, including treatment modalities and clinical outcomes.

Methods

- This was a non-interventional, retrospective study using clinical chart data from early-stage breast cancer patients diagnosed between 2018 and 2021 at Chang Gung Memorial Hospital, Linkou and Taipei branches, Taiwan.
- Information on patient demographics, treatment patterns, and healthcare utilization within the first three years after diagnosis was extracted from medical records and entered into a standardized electronic case report form (eCRF) via an online platform.
- Descriptive analyses were used to summarize patient demographics and HCU across different subtypes. Continuous variables (e.g., age, number of outpatient visits, length of stay) were presented as means with standard deviations (SD), and medians with interquartile ranges (IQR). Categorical variables (e.g., clinical stage, treatment modality) were summarized as counts and percentages.
- Generalized estimating equations (GEE) were applied to examine associations between patient characteristics and HCU. Adjusted odds ratios (aORs) with corresponding 95% confidence intervals (CIs) for the association between subtypes and higher healthcare utilization were estimated. All statistical tests were two-tailed, with p-values <0.05 considered statistically significant.

Results

Characteristics of Early-stage Breast Cancer Patients

- Among 1,698 patients, most of them were HER2−/HR+ subtype (68.49%, n=1163), 23.26% (n=395) were HER2+, and 8.24% (n=140) were TNBC (**Table 1**).
- The mean age of patients with HER2−/HR+ was 53.70 years (SD: 11.40), HER2+ was 52.60 (SD: 10.70), and TNBC was 55.10 (SD: 11.50).
- Majority of patients were diagnosed between 2019 and 2020.
- A higher proportion of BC patients had stage 2 cancer (HER2−/HR+: 50.99%; HER2+: 63.04%; TNBC: 62.86%) and lymph node negative (71.20%; 60.76%; 62.14%).

Treatment and Clinical Outcomes by Subtypes

- Most early breast cancer patients underwent breast-conserving surgery (HER2+: 56.96%; HER2+/HR+: 64.40%; TNBC: 65.71%, while about one-third of patients received mastectomy (36.20%; 29.92%; 30.00%) (**Table 2**).
- Neoadjuvant treatment was most frequently used in TNBC (45.00%), followed by HER2+ (38.48%) and HER2−/HR+ (18.49%). Pathological completed response rates among those receiving neoadjuvant therapy were highest in HER2+ patients (60.53%), followed by TNBC (50.79%) and HER2−/HR+ (26.51%).
- Adjuvant treatment was common across subtypes, with the highest proportion in HER2−/HR+ (96.30%) and HER2+ (95.19%), but lower in TNBC (75.00%). Treatment regimens varied by subtypes: chemotherapy, hormone therapy, and targeted therapy was most common in HER2+ (48.10%), chemotherapy plus hormone therapy in HER2−/HR+ (47.64%), and chemotherapy alone in TNBC (60.00%). Relapse rates were highest in TNBC (8.57%), compared with 3.44% in HER2−/HR+ and 2.78% in HER2+.

Table 1. Demographics and Disease Characteristics of Early-stage Breast Cancer Patients

	HER2+		HER2- / HR+		TNBC	
Number of patients	395		1163		140	
Age						
mean, SD	52.60	10.70	53.70	11.40	55.10	11.50
median, IQR	51.80	44.32 - 60.82	52.30	45.56 - 61.66	55.70	48.27 - 63.43
BMI						
mean, SD	24.30	4.30	24.50	4.30	24.40	4.70
median, IQR	23.50	21.49 - 26.13	23.70	21.41 - 26.70	23.80	21.29 - 26.20
Initial diagnosis year	n	%	n	%	n	%
2018	32	8.10%	64	5.50%	5	3.57%
2019	201	50.89%	640	55.03%	77	55.00%
2020	106	26.84%	360	30.95%	44	31.43%
2021	56	14.18%	99	8.51%	14	10.00%
Clinical stage	n	%	n	%	n	%
stage I	105	26.58%	482	41.44%	31	22.14%
stage II	249	63.04%	593	50.99%	88	62.86%
stage III	41	10.38%	88	7.57%	21	15.00%
Lymph node	n	%	n	%	n	%
negative	240	60.76%	828	71.20%	87	62.14%
positive	155	39.24%	334	28.72%	53	37.86%

Abbreviations: human epidermal growth factor receptor 2, HER2; hormone receptor, HR; triple negative breast cancer, TNBC; standard deviation, SD; interquartile range, IQR.
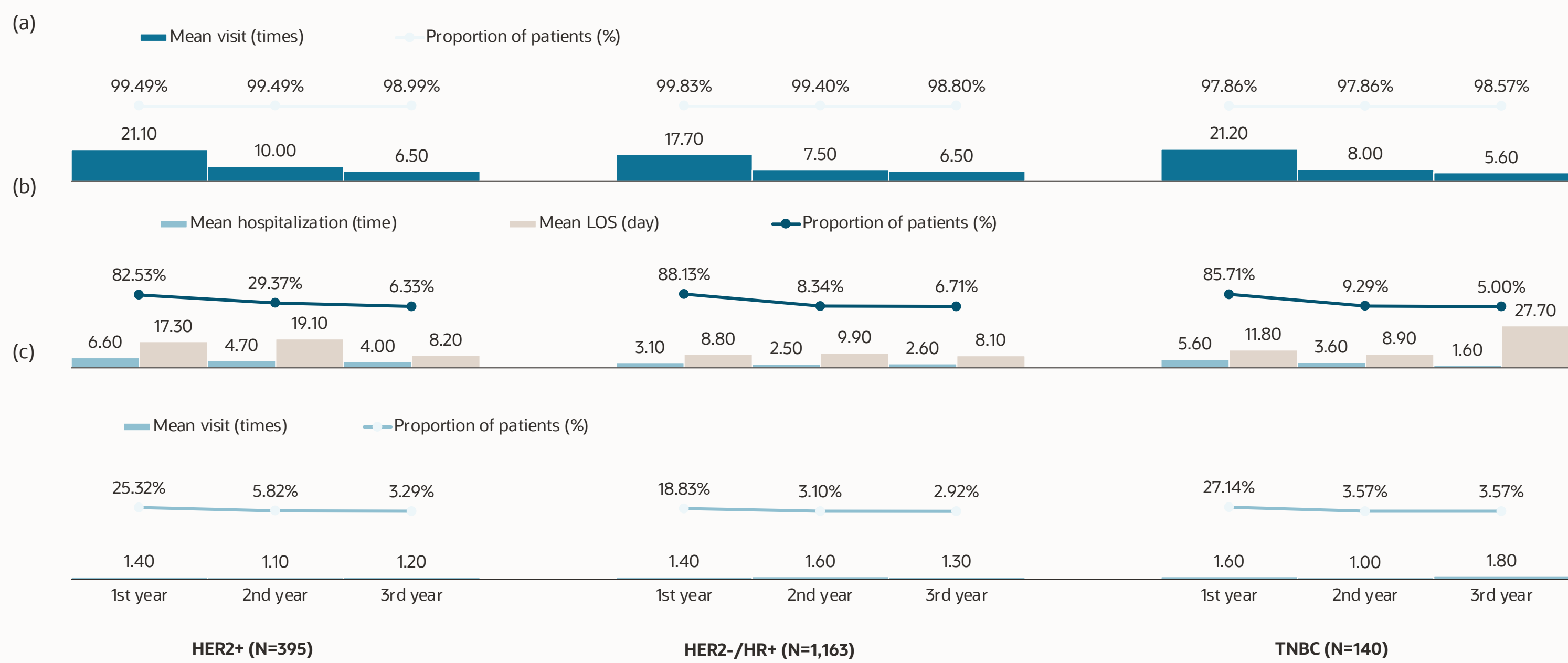
Table 2. Treatment Modalities and Clinical Outcomes

	HER2+		HER2- / HR+		TNBC	
Number of patients	395		1163		140	
	n	%	n	%	n	%
Surgery						
mastectomy	143	36.20%	348	29.92%	42	30.00%
conserving surgery	225	56.96%	749	64.40%	92	65.71%
no surgery	27	6.84%	66	5.67%	6	4.29%
Neoadjuvant treatment						
yes	152	38.48%	215	18.49%	63	45.00%
no	243	61.52%	948	81.51%	77	55.00%
Pathological complete response						
yes	92	60.53%	57	26.51%	32	50.79%
no	60	39.47%	158	73.49%	31	49.21%
Treatment regimen						
chemotherapy only	6	1.52%	45	3.87%	84	60.00%
chemotherapy and hormone therapy	29	7.34%	554	47.64%	6	4.29%
chemotherapy, hormone and targeted therapy	190	48.10%	17	1.46%	1	0.71%
chemotherapy and targeted therapy	115	29.11%	5	0.43%	7	5.00%
hormone therapy only	31	7.85%	474	40.76%	0	0.00%
immunotherapy	6	1.52%	18	1.55%	28	20.00%
other therapy	18	4.56%	50	4.30%	14	10.00%
Relapse						
yes	11	2.78%	40	3.44%	12	8.57%
no	384	97.22%	1123	96.56%	128	91.43%

Abbreviations: human epidermal growth factor receptor 2, HER2; hormone receptor, HR; triple negative breast cancer, TNBC.

Annual Healthcare Utilizations in Early-stage Breast Cancer by Subtypes

- Outpatient visits were highly prevalent in all three years after diagnosis, with >97% of patients having at least one visit annually. The mean number of visits declined over time, from 17.70–21.10 in the first year to 5.60–6.50 in the third year, with HER2+ and TNBC patients having slightly higher first-year visit counts than HER2−/HR+ patients (**Figure 1a**).
- Inpatient hospitalisations were most common in the first year (82.55–88.13% of patients), declining sharply in subsequent years in the second and the third year for all subtypes. HER2+ patients had the highest first-year hospitalisation rate (82.55%) and longest length of stay (17.30 days), while TNBC patients had the longest length of stay overall in the third year (27.70 days) despite a low proportion hospitalized (5.00%) (**Figure 1b**).
- Emergency room visits were less frequent overall. In the first year, TNBC patients had the highest proportion (27.14%) compared with HER2 (25.32%) and HER2−/HR+ (18.83%). For all subtypes, ER visit proportions dropped to <6% in the second and third years, with mean visits per year remaining between 1.00 and 1.80 (**Figure 1c**).

(a) Mean visit (times) / Proportion of patients (%)

(b) Mean hospitalization (time) / Mean LOS (day) / Proportion of patients (%)

(c) Mean visit (times) / Proportion of patients (%)

HER2+ (N=395) | HER2-/HR+ (N=1,163) | TNBC (N=140)

Abbreviations: human epidermal growth factor receptor 2, HER2; hormone receptor, HR; triple negative breast cancer, TNBC; length of stay, LOS.

Association Between Patient Characteristics and Healthcare Utilization

- The year of follow-up was strongly associated with outpatient visits. Compared with the third year after diagnosis, patients in the first year had nearly three times as many outpatient visits (aOR [95%CI], 2.93 [2.84–3.02], P<.0001), while those in the second year had 27% more visits (1.27 [1.22–1.31], P<.0001). Patients who received adjuvant treatment had a slight increase in outpatient visits (1.13 [1.02–1.26], P=.0192). Those treated with immunotherapy (2.12 [1.75–2.57]) or combined chemotherapy, hormone therapy, and targeted therapy (1.86 [1.54–2.25]) had significantly more outpatient visits (all P<.0001). Patients who experienced relapse had 16% more outpatient visits (1.16 [1.06–1.26], P=.0007) (**Figure 2**).

- Hospitalization patterns were similar: the chance of being hospitalized was highest in the first year (aOR [95%CI], 1.71 [1.47–2.00], P<.0001) and lower in the second year (0.77 [0.65–0.92], P=.0036) compared to the third. HER2+ patients had fewer hospitalizations compared to TNBC (0.80 [0.64–0.99], P=.0412). Patients who had surgery were also less likely to be hospitalized (0.80 [0.65–0.97], P=.0217). The greatest increase in hospitalization was seen in patients receiving combined chemotherapy, hormone therapy, and targeted therapy (4.96 [2.78–8.82], P<.0001) (**Figure 3**).
- Length of stay did not differ much across follow-up years. Patients who achieved complete pathological response stayed in hospital for a significantly shorter time (aOR [95%CI], 0.56 [0.41–0.76], P=.0002), while those who relapsed stayed much longer (2.35 [1.75–3.15], P<.0001) (**Figure 4**).

Figure 2. Association Between Characteristics and Outpatient Visit

	aOR	95%CI		P-value
Year of follow-up period (reference: third year)				
first year	2.93	2.84	3.02	<.0001
second year	1.27	1.22	1.31	<.0001
Subtype at initial diagnosis (reference: TNBC)				
HER2+	1.01	0.92	1.12	0.7841
HER2- & HR+	1.03	0.95	1.12	0.5067
Initial diagnosis year (reference: 2018)				
2019	1.05	0.98	1.13	0.1917
2020	1.08	1.00	1.16	0.0575
2021	1.01	0.92	1.10	0.8767
Clinical stage (reference: stage I)				
stage II	0.99	0.95	1.03	0.5432
stage III	1.06	0.98	1.14	0.1369
Surgery (reference: no surgery)				
yes	1.04	0.97	1.11	0.3013
Neoadjuvant treatment (reference: no treatment)				
yes	1.00	0.95	1.06	0.9458
Pathological complete response (reference: no response)				
yes	0.98	0.91	1.04	0.4771
Adjuvant treatment (reference: no treatment)				
yes	1.13	1.02	1.26	0.0192
Treatment regimen (reference: without treatment)				
chemotherapy only	1.65	1.38	1.98	<.0001
chemotherapy and hormone therapy	1.57	1.31	1.87	<.0001
chemotherapy, hormone and targeted therapy	1.86	1.54	2.25	<.0001
chemotherapy and targeted therapy	1.76	1.46	2.12	<.0001
hormone therapy only	1.19	1.00	1.42	0.0565
immunotherapy	2.12	1.75	2.57	<.0001
other therapy	1.83	1.49	2.24	<.0001
Relapse (reference: no relapse)				
yes	1.16	1.06	1.26	0.0007

Abbreviations: adjusted odds ratio, aOR; confidence interval, CI; human epidermal growth factor receptor 2, HER2; hormone receptor, HR; triple negative breast cancer, TNBC

Figure 3. Association Between Characteristics and Hospitalization

	aOR	95%CI		P-value
Year of follow-up period (reference: third year)				
first year	1.71	1.47	2.00	<.0001
second year	0.77	0.65	0.92	0.0036
Subtype at initial diagnosis (reference: TNBC)				
HER2+	0.80	0.64	0.99	0.0412
HER2- & HR+	0.85	0.70	1.03	0.0902
Initial diagnosis year (reference: 2018)				
2019	1.12	0.95	1.35	0.2228
2020	1.11	0.91	1.34	0.3009
2021	0.71	0.56	0.91	0.0057
Clinical stage (reference: stage I)				
stage II	1.01	0.90	1.12	0.9165
stage III	1.07	0.91	1.27	0.4185
Surgery (reference: no surgery)				
yes	0.80	0.65	0.97	0.0217
Neoadjuvant treatment (reference: no treatment)				
yes	1.49	1.33	1.68	<.0001
Pathological complete response (reference: no response)				
yes	0.90	0.79	1.03	0.1245
Adjuvant treatment (reference: no treatment)				
yes	1.07	0.86	1.32	0.5660
Treatment regimen (reference: without treatment)				
chemotherapy only	2.85	1.61	4.98	0.0003
chemotherapy and hormone therapy	2.61	1.48	4.60	0.0009
chemotherapy, hormone and targeted therapy	4.96	2.78	8.82	<.0001
chemotherapy and targeted therapy	4.79	2.70	8.51	<.0001
hormone therapy only	1.01	0.57	1.80	0.9627
immunotherapy	3.33	1.86	5.96	<.0001
other therapy	3.60	1.96	6.62	<.0001
Relapse (reference: no relapse)				
yes	0.90	0.74	1.11	0.3273

Abbreviations: adjusted odds ratio, aOR; confidence interval, CI; human epidermal growth factor receptor 2, HER2; hormone receptor, HR; triple negative breast cancer, TNBC

Figure 4. Association Between Characteristics and Length of Stay

	aOR	95%CI		P-value
Year of follow-up period (reference: third year)				
first year	1.49	0.94	2.54	0.0882
second year	1.54	0.81	2.21	0.2586
Subtype at initial diagnosis (reference: TNBC)				
HER2+	1.18	0.72	1.93	0.5166
HER2- & HR+	0.92	0.59	1.45	0.7223
Initial diagnosis year (reference: 2018)				
2019	0.80	0.56	1.12	0.1931
2020	0.74	0.51	1.06	0.0959
2021	0.52	0.32	0.84	0.0077
Clinical stage (reference: stage I)				
stage II	1.16	0.89	1.51	0.2723
stage III	1.01	0.68	1.49	0.9684
Surgery (reference: no surgery)				
yes	1.22	0.73	2.04	0.4447
Neoadjuvant treatment (reference: no treatment)				
yes	2.23	1.72	2.87	<.0001
Pathological complete response (reference: no response)				
yes	0.56	0.41	0.76	0.0002
Adjuvant treatment (reference: no treatment)				
yes	1.14	0.65	2.01	0.6509
Treatment regimen (reference: without treatment)				
chemotherapy only	0.94	0.30	2.94	0.9220
chemotherapy and hormone therapy	1.14	0.37	3.55	0.8187
chemotherapy, hormone and targeted therapy	1.60	0.51	5.04	0.4228
chemotherapy and targeted therapy	1.84	0.59	5.77	0.2947
hormone therapy only	0.80	0.26	2.49	0.7000
immunotherapy	1.54	0.41	4.38	0.6257
other therapy	1.74	0.54	5.62	0.3520
Relapse (reference: no relapse)				
yes	2.35	1.75	3.15	<.0001

Conclusion

- In this 3-year follow-up study of early breast cancer in Taiwan, healthcare utilization patterns varied significantly by follow-up year, subtype, and treatment intensity.
- Across subtypes, healthcare utilization declined over time but remained substantial, underscoring the sustained burden of survivorship care.
- These findings highlight the importance of tailoring follow-up strategies and resource allocation to the evolving needs of patients to reduce both the clinical and economic impact of early breast cancer in Taiwan.

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