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RESEARCH ARTICLE

Analysis of cost of illness and diagnosis-related group payment system in breast cancer patients with chemotherapy in Indonesia

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Abstract

Background: Often, breast cancer patients undergoing chemotherapy sacrifice their finances, and the financial costs also affect the government. **Objective:** This study aims to analyse the cost of illness and the application of an insurance payment system among breast cancer patients receiving various chemotherapy regimens. **Method:** This study was retrospective and used a bottom-up prevalence approach. Data were collected from a secondary hospital between 2020 and 2021. The inclusion criteria were breast cancer patients undergoing chemotherapy. Patients with incomplete detailed cost data were excluded. The cost of illness was calculated from direct medical costs and the estimated non-medical and indirect costs. **Results:** The cost of illness for a chemotherapy visit for a breast cancer patient spanned from USD 130.37 to USD 932.05. However, these values did not include healthcare service costs and laboratory tests. The highest regimentation chemotherapy cost is for the combination of docetaxel–cyclophosphamide–trastuzumab. There was a significant margin between insurance claims and variable medical costs ($p < 0,05$), ranging between USD 24.21 and 104.83. **Conclusion:** The cost of illness for chemotherapy for breast cancer patients is high, and the coverage of the diagnosis-related payment system is limited. Therefore, the government should accelerate prevention programmes to reduce the incidence of cancer.

Introduction

Breast cancer contributes significantly to the increasing mortality rates worldwide, with more than 2.26 million new breast cancer cases found in women in 2020 (Sung *et al.*, 2021). Most breast cancer cases (80%) are advanced and require complex treatments (Ministry of Health, Republic of Indonesia, 2018). In Indonesia, data from the International Agency for Research on Cancer show that there were 65,858 new breast cancer cases in 2020, with the incidence rate estimated at

12/100,000 in women (Sung *et al.*, 2021). The Basic Health Research (Riskesdas) data also shows that cancer cases in Indonesia increased from 1.4% in 2013 to 1.8% in 2018 (Ministry of Health Republic of Indonesia: Research and Health Development Agency, 2018).

Chemotherapy is used in a locally advanced cancer stage (Dhanushkodi *et al.*, 2021). Due to the high costs, patients with economic disadvantages may not opt for chemotherapy. They may also delay and even stop treatment, which worsens their condition (Carrera *et*

al., 2019). From a macro perspective, cancer also contributes considerably to increasing the burden of the government's spending. The cancer care is projected to increase by 34% (Mariotto et al., 2020). One component that incurs a significant cost is the administration of chemotherapy (Carrera et al., 2018).

Understanding the treatment costs for cancer is essential for informing policymaking. However, there is only limited information about the total cost incurred by cancer patients for each visit to receive various chemotherapy regimens. In addition, there has not been any evaluation of the implementation of the diagnosis-related group payment system by the government. Therefore, this study analyses the cost of illness (COI) and the national health insurance's payment system for breast cancer chemotherapy visits.

Methods

Design and setting

This research analysed the COI using a bottom-up prevalence approach and the economic burden from patients' perspective. Data were collected via a purposive sampling technique from breast cancer patients' chemotherapy visits between May 2020 and May 2021 at Airlangga University Hospital. The data were secondary in the form of patient care cost data. In addition to medical record data, the analysis also considered the average regional minimum wage in the province of East Java between 2020 and 2021. Ethical permission was obtained from the Airlangga University Hospital's health research ethics committee with No.007/KEP/2022.XX.

Participants

The inclusion criteria for this study were: (1) all breast cancer patients undergoing chemotherapy based on the claim code at Airlangga University Hospital regardless of the treatment cycle, and (2) patients visiting the hospital from May 2020 to May 2021. The exclusion criteria for this study were patients with missing data (national health insurance claims data, total cost data from the cashier's billing, and pharmacy billing data).

Variables and data measurement

The COI was calculated from direct medical costs and the estimated direct non-medical and indirect costs. Data on the direct medical costs was obtained from the cashier's bill per patient visit, which includes administrative fees, drug costs (total non-chemotherapeutic and chemotherapeutic drugs),

medical services, medical devices, other pharmaceutical supplies, medical actions, laboratory, and hospitalisation (Ministry of Health Republic Indonesia, 2015). The direct non-medical cost was calculated from the transportation cost to travel from home to the hospital to receive chemotherapy treatment, estimated in monetary units. The distance between the home and the hospital was estimated using Google Maps. The travel cost was calculated by multiplying the round trip of a car's fuel consumption (0.083 L/km) and fuel prices in 2020-2021 (0.53 USD/litre). The indirect costs were obtained from the patients' decreased productivity and their families, who left work to assist with the treatment. The formula for calculating the cost of reduced productivity was the multiplication of two people, the value of the patient's income per day according to the average minimum regional wage, and the days spent for treatment.

Data analysis

All the data obtained were totalled and grouped according to the cost type. Data analysis also considered the direct medical costs the hospital must incur and the margin between these costs and the national health insurance claims. A statistical analysis of the different medical variables and claims was done using the Wilcoxon signed-rank method.

Results

This study included 144 patients diagnosed with breast cancer who underwent chemotherapy between May 2020 and May 2021. A total of 123 patients' data met the study inclusion criteria. Table I shows that the sample comprised 97.56% women and 2.44% men. Twenty-one patients were excluded because the information about the cashier's billing, such as the regimen data and chemotherapy drug costs, was incomplete. Age-wise, patients mainly were aged 40-60 years. Most live in the city where this research was conducted. Most patients were registered in the highest class of health insurance, namely Class 1.

Table II shows the total economic burden or COI of breast cancer patients receiving chemotherapy, ranging from USD 130.37 to USD 932.05. On average, direct medical costs contributed the highest percentage to the total COI (95.45%) compared to non-direct medical and indirect costs. Common direct medical cost components consisted of administrative charges, medical services, medical support services, cancer drugs, discharge medications, premedication drugs, drugs while undergoing chemotherapy, medical devices, room rent, consumable medical materials, and

pharmaceutical supplies. However, the average differed for each patient. The costs of chemotherapy and service fees borne by hospitals and the government for each visit of a breast cancer patient were included in the calculation. The combination of docetaxel, cyclophosphamide, and trastuzumab incurred the highest direct medical cost, i.e. USD 909.67 per patient. In contrast, the capecitabine regimen incurred the lowest cost, with an average of USD 109.42 per patient.

Table I: Patients' characteristics

Criteria	Frequency and percentage (n=123)
Gender	
Male	120 (97.56)
Female	3 (2.44)
Age	
Under 40 years	25 (20.33)
40 – 60 years	73 (59.34)
Above 60 years	25 (20.33)
Assurance class	
Class 1	98 (79.67)
Class 2	6 (4.88)
Class 3	19 (15.45)
Patient's domicile	
Surabaya	82 (66.67)
Sidoarjo	14 (11.38)
Gresik	19 (15.45)
Blitar	8 (6.50)

The non-direct medical and indirect costs had substantially lower percentages, at 0.43% and 4.12%, respectively, because the analysis only considered transportation costs from home to the hospital for chemotherapy treatment. Meanwhile, the indirect cost only included the cost of decreased productivity due to illness/treatment per day.

From the overall results, the margin in income that healthcare facilities may receive was USD 6,395.91 (1.47 x Indonesia's GDP) for the 123 outpatient and inpatient visits. The margin in revenue is allocated to provide services and other development the hospital needs. The margin between the claim rate of the Indonesian Case Base Group (INA CBG) and the lowest total cost was on the cyclophosphamide-doxorubicin regimen at USD 24.21. The most significant margin was in the regimen of docetaxel-carboplatin, which amounted to USD 104.83 per visit, followed by docetaxel-cyclophosphamide-epirubicin, with a cost of USD 103.44 per visit.

Out of the 14 regimens that underwent statistical testing, only nine were chosen for further analysis

because each regimen comprised five participants. The results of these nine regimens were significantly different, as shown by the p -value <0.05 . Patients undergoing a single vinorelbine regimen and a combination of vinorelbine-carboplatin exhibited the most significant margin between the total cost and the cost of claims (p -value=0.000 <0.05). While the docetaxel-carboplatin regimen showed the highest margin between total cost and cost of claims, the single vinorelbine regimen and vinorelbine-carboplatin combination, despite representing nearly 40% of the number of the study subjects, demonstrated the most statistically meaningful margin.

Discussion

This study overviews the resources and costs of breast cancer services in Indonesia (especially at Airlangga University Hospital). The payment method under consideration is the case-based payment system called Casemix, which was established in 2008 for the National Health Insurance in Indonesia. The implementation involves a payment pattern for advanced health facilities termed the Indonesian Case Base Group (INA-CBGs) (Ministry of Health Republic of Indonesia, 2014).

Breast cancer management incurs a substantial financial burden, as evidenced by the total direct cost of treating breast cancer patients during this study. The total spending for all stages was USD 803,820.99 for 123 visits, a figure considered excessive, given the low number of participants. The average economic burden per patient visit for chemotherapy was USD 6535.13, as high as other chronic diseases (Patty *et al.*, 2022). Direct costs contribute the highest proportion to the total cost, which component variables can change when applied elsewhere. The more progressive the disease (at advanced stages), the more the patients need health resources and therapy regimens.

In this study, the average COI per chemotherapy visit for a breast cancer patient was half of the COI in previous research (Mamo *et al.*, 2017). The low COI could be attributable to the government's implementation of the package system, which compels health facilities to make the clinical pathway more cost-effective (Lawal *et al.*, 2019). This study also observed that patients went to a public laboratory outside the hospital for laboratory tests before receiving chemotherapy and other necessary support. The retrospective data collected in this research allows for estimating non-direct and indirect costs from the medical records.

Table II: Total cost of illness in various chemotherapy regimens of breast cancer patients (in USD; 1 USD = Rp. 14.269 (Data BI, 2021))

Chemotherapy regimentation	Total	Average of direct medical cost [†]	Average of non-direct medical cost	Average of indirect cost	Average of total COI [‡]	Total direct medical cost [§]	Total services and chemotherapy drug	Total cost [§]	Total claim /tariff INA CBG's	Margin between total claim & total cost [§]	P-value	Z-value
Doxorubicin cyclophosphamide (AC)	1	325.09	1.11	19.59	345.79	325.09	267.94	57.15	81.37	24.21	-	-
Docetaxel	2	424.68	0.50	19.63	444.81	849.37	747.09	102.28	162.73	60.45	-	-
Docetaxel doxorubicin cyclophosphamide (TAC)	15	427.48	1.58	19.14	448.20	6,412.20	5,523.90	888.30	1,688.34	800.04	0.005*	-2.840
Docetaxel carboplatin	10	394.08	0.47	19.63	414.18	3,940.83	3,404.57	536.26	1,584.51	1,048.25	0.005*	-2.803
Docetaxel cyclophosphamide (TC)	7	383.73	8.34	13.66	405.72	2,686.10	2,220.91	465.19	1,015.31	550.12	0.018*	-2.366
Docetaxel cyclophosphamide epirubicin	10	434.12	1.82	18.71	454.66	4,341.21	3,726.93	614.28	1,648.69	1,034.41	0.005*	-2.803
Docetaxel cyclophosphamide trastuzumab	16	909.67	1.76	20.62	932.05	14,554.75	13,536.40	1,018.34	1,691.13	672.79	0.005*	-2.792
Capecitabine	1	109.42	0.85	20.09	130.37	109.42	72.43	37.00	81.37	44.37	-	-
Carboplatin	1	276.26	0.77	20.09	297.12	276.26	224.16	52.10	81.37	29.26	-	-
Paclitaxel carboplatin	6	393.86	0.32	20.09	414.28	2,363.18	2,114.57	248.61	893.10	644.49	0.028*	-2.201
Cyclophosphamide epirubicin fluorouracil	7	399.46	2.66	18.24	420.36	2,796.23	2,397.53	398.71	569.56	170.85	0.028*	-2.197
Trastuzumab	2	755.78	0.49	20.09	776.36	1,511.55	1,417.65	93.90	162.73	68.83	-	-
Vinorelbine	28	526.84	2.15	19.84	548.82	14,751.46	13,118.83	1,632.62	2,407.99	775.37	0.000*	-4.623
Vinorelbine carboplatin	17	477.30	5.24	19.88	502.42	8,114.05	7,203.32	910.73	1,383.21	472.48	0.000*	-3.621
Total	123	6,237.78	28.06	269.30	6,535.13	63,031.70	55,976.22	7,055.48	13,451.39	6,395.91		
% of total COI		95.45%	0.43%	4.12%	100.00%							

†: Administration fees, services, medical services, medical support services, cancer drugs, hospital discharge drugs, premedication drugs, drugs while undergoing chemotherapy, medical devices, room rental, medical consumables and other pharmaceutical supplies per patient; ‡: Average amount of direct medical cost + average non-direct cost + average indirect medical cost; §: Average hospital billing x number of patients in each regimen; §: Total direct medical cost – (total services + therapeutic drugs); §: Margin between total cost and total claim; *: p-value < 0.05, significantly different

The results showed that chemotherapy cancer patients spent the most on direct medical costs. The proportion was substantially higher than other costs (Yabroff *et al.*, 2021) due to drug prices, especially for combined chemotherapy regimens needed at an advanced stage with certain malignancies or complications. Other costs include medical services such as chemotherapy drug handling (e.g. reconstitution, diagnostic costs, medical personnel costs, radiation, and surgical procedures) (Gunn *et al.*, 2021; Yabroff *et al.*, 2021).

The distribution of services within the national health insurance tariff system is regulated by local policies (Ministry of Health Republic Indonesia, 2023). The administration of chemotherapy cannot be denied, which makes the disease's burden heavier. Therefore, preventive measures, such as promoting vaccination and healthy lifestyles, are warranted to prevent terminal illnesses. In addition, regular screening needs to be supported by the government because it can decrease breast cancer mortality among women under 70 by 25% by 2030 and 40% by 2040 (World Health Organisation, 2023).

The chemotherapeutic drug vinorelbine can be used alone or in combination. Vinorelbine inhibits the polymerisation of tubulin dimers into microtubules, which inhibits mitotic formation and prevents tumour cell division in breast cancer stages 1 to 4 (Gao *et al.*, 2015; NCCN, 2020). Meanwhile, Trastuzumab is a targeted therapy to inhibit the tyrosine kinase pathway by binding it to the extracellular portion of HER2 (Maadi *et al.*, 2021). Trastuzumab is a monoclonal antibody designed with a specific target, so its production is more expensive. In contrast, the capecitabine regimen is a combination drug with the lowest and average direct medical costs. Capecitabine is an oral preparation that does not require medical devices, single-use devices, or other pharmaceutical supplies in the handling process. It is effective for adjunctive treatment in breast cancer patients with advanced conditions as an anti-metabolic fluoropyrimidine deoxynucleoside carbamate (Xu *et al.*, 2019).

The package rates set by the government are the total claims received by the healthcare providers, including drugs after the patients are discharged. Non-direct medical costs were relatively low because most of the patients in this study were locals and data were retrospective, which impeded determining other non-direct medical cost components, such as waiting time, travel time, homecare costs, and keeping patients at home unassisted (Pisu *et al.*, 2018). The indirect costs were also low because the number of days the patient skipped work or activities for treatment was one to two days. The regional minimum wage of USD 301.39

monthly (East Java Government, 2021) could also influence the overall costs.

Conclusion

Breast cancer is a major health problem with burdensome treatment, especially chemotherapy. Expensive targeted and specific chemotherapy drugs and services increase the direct medical costs to be borne by patients and the government. Meanwhile, government-set capitation fees have not provided sufficient resources to improve services for cancer patients. National health insurance policymakers must allocate costs optimally to provide comprehensive management and preventive measures before cases develop into advanced and terminal stages. The findings in this study also suggest that the current cancer chemotherapy health systems need to be supported by early detection and screening programmes to reduce mortality, morbidity, and economic burden. In this research, retrospective data posed limitations, particularly in accessing indirect costs and disease severity information. Real-time data collection in future studies could achieve a more detailed understanding of the disease and its associated side effects and costs.

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