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FACTORS AFFECTING HOSPITALISATION COSTS PER ADMISSION FOR CERVICAL CANCER PATIENTS

(Faktor yang Mempengaruhi Kos Penghospitalan Setiap Kemasukan Pesakit Kanser Serviks)

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ABSTRACT

Cervical cancer ranks among the top ten most prevalent cancers in Malaysia, and it is the second most common cancer in women. A lot of money has been said to be spent on treating cervical cancer. That's why the community and health care professionals need to know how much it will cost to treat this cancer. The purpose of this study is to estimate the average cost of cervical cancer treatment and to determine the factors that influence this cost. From 2013 to 2022, 829 cervical cancer patient samples were collected by the International Casemix and Clinical Coding Centre (ITCC), Hospital Canselor Tuanku Muhriz (HCTM). Among the information gathered includes the treatment cost for one episode of care, the patient's age, clinical factors such as the length of their hospital stay, presence of additional medical issues, cancer severity level, kind of metastasis, type of treatment, and the patient's discharge status. Regression analysis was employed in this investigation. The skewed structure of the treatment cost data is taken into account by including a logarithmic adjustment, which transforms the model for treatment cost estimation. The results demonstrate that the cost of treatments is affected by a number of factors. These factors include the severity of the cancer,the length of hospital stay, the presence of kidney failure or brain metastases, and the type of treatment (surgery, etc.). Decreases in treatment expenses are observed in patients who are older, who have heart disease or bone metastases, who have undergone radiation treatment, and who are homebound upon discharge.

Keywords: cervical cancer; treatment costs; multiple linear regression

ABSTRAK

Kanser serviks berada dalam kedudukan kesepuluh kanser yang paling biasa di Malaysia, dan ia adalah kanser kedua dalam kalangan wanita. Kanser serviks masih merupakan satu daripada sepuluh jenis kanser yang paling biasa di Malaysia. Banyak wang telah dikatakan dibelanjakan untuk merawat kanser serviks. Oleh itu, masyarakat dan penjaga kesihatan profesional perlu tahu kos yang diperlukan untuk merawat kanser ini. Tujuan kajian ini adalah untuk menganggarkan purata kos rawatan kanser serviks dan menentukan faktor yang mempengaruhi kos ini. Dari tahun 2013 hingga 2022, sebanyak 829 sampel pesakit kanser serviks telah dikumpul oleh International Casemix and Clinical Coding Centre (ITCC), Hospital Canselor Tuanku Muhriz (HCTM). Antara maklumat yang dikumpul termasuk kos rawatan untuk satu episod penjagaan, umur pesakit, faktor klinikal seperti tempoh penginapan mereka di hospital, kehadiran masalah kesihatan lain, tahap keterukan kanser, jenis metastasis, jenis rawatan, dan status discaj pesakit. Analisis regresi digunakan dalam kajian ini. Mengambil kira sifat pencongan data kos rawatan, transformasi logaritma dilakukan ke atas model anggaran kos rawatan. Keputusan menunjukkan bahawa kos rawatan dipengaruhi oleh beberapa faktor. Faktor-faktor ini termasuk keterukan kanser, tempoh tinggal di hospital, kehadiran kegagalan buah pinggang atau metastasis otak, dan jenis rawatan (pembedahan, dll.). Pengurangan dalam perbelanjaan rawatan diperhatikan pada pesakit yang lebih tua, yang mempunyai penyakit jantung atau metastasis tulang, yang telah menjalani rawatan radiasi, dan yang pulang ke rumah.

Kata kunci: kanser serviks; kos rawatan; regresi linear berganda

1. Introduction

Cancer is a disease whereby abnormal cells grow uncontrollably in the body and spread to other organs (Mathur *et al.* 2015). According to the National Cancer Institute (NCI) (2023), there are two forms of cervical cancer: squamous cell carcinoma and adenocarcinoma. The majority of cervical cancer is squamous cell carcinoma, which originates in the ectocervix. With adenocarcinoma, cancer cells will start to multiply in endocervical gland cells. Furthermore, there are cervical cancers with characteristics of both squamous cell carcinoma and adenocarcinoma. This is known as mixed carcinoma. Cervical cancer mostly results from human papillomavirus (HPV) infection (Domingo *et al.* 2008). Sexual activity is another risk factor for cervical cancer. Many factors contribute to this, such as the frequency of sexual partners, the age of first intercourse, and the usage of condoms during intercourse (Shepherd *et al.* 2000). Vesco *et al.* (2011) further noted that smoking is the sole non-sexually transmitted cause of cervical cancer.

Ab Manan *et al.* (2015, 2019) reported that among cancer types in Malaysia from 2007 to 2016, cervical cancer ranked tenth. 4,352 women were diagnosed with cervical cancer between 2007 and 2011, then 3,981 from 2012 to 2016. This outcome shows almost 8.5% reduction in the cervical cancer incidence. With regard to the age-standardized rate (ASR), an age-specific weighted average expressed per 100,000 persons, the incidence of cervical cancer dropped from 7.6 in 2007 to 6.2 in 2011 (Ab Manan *et al.* 2019). ASR lets you quickly compare several time periods. Though its prevalence has dropped, cervical cancer still ranks second most common cancer among Malaysian women (Seng *et al.* 2018).

Compared to other countries, especially developing Asian countries, Malaysia's five-year survival rate is higher at 71.1% (Muhamad *et al.* 2015). This remarkable survival rate in Malaysia for cervical cancer patients is attributed to the availability of innovative treatment choices and improved hospital technology. Surgery, radiation, chemotherapy, cancer staging, histology, and palliative care are typical components of cervical cancer treatment plans. According to the World Health Organisation (WHO), a histological examination is performed to diagnose cervical cancer (WHO 2022). Cancer stage is assessed by the size of the tumour and the spread of cancer cells, allowing methods of treatment to be tailored to the cancer stage (WHO 2022). Next, the type of treatment given to cervical cancer patients differs depending on the stage of the disease (Horn *et al.* 2007). Finally, palliative care is an important aspect of cancer management since it relieves disease-related pain and suffering while improving quality of life (WHO 2022).

Radiation machines, CT scanners, and other expensive medical equipments, as well as the medications and drugs needed to treat cancer, drive up the cost of cancer care. Cancer patients in Malaysia still have to pay a part of the bill, even if the government has subsidised some of the costs. There is still limited information available about the estimated cost of cervical cancer treatment, particularly at the patient's own expense. The community isn't ready for the financial load that often comes with medical care because they don't have a clear idea of how much cervical cancer treatment costs. This lack of clear information about costs can make things very hard financially, forcing families to make difficult choices between essential needs and life-saving treatments. This highlights the importance for studies that can measure treatment costs and the variables that affect them.

2. Methodology

This study utilises data from the ITCC, HCTM on the population of patients with cervical cancer. The study covers a period of ten years, beginning on January 1, 2013, and ending on

December 31, 2022. The study received ethical approval from the UKM Research Ethics Committee (UKM PPI/111/8/JEP-2023-481) on August 11. 2023. The data was collected and documented based on disease diagnosis using the International Classification of Diseases coding system (ICD-10). The cases were categorised according to the severity of the patients. A total of 829 samples were collected from the patient's medical records in the relevant database. The collected data included characteristics such as age, clinical factors (such as severity and duration of hospitalisation), comorbidities (such as heart disease and kidney illness), treatment methods, types of metastases, discharge status, and hospital charges. This study utilised multiple linear regression analysis to determine the relationship between hospital costs for patients with cervical cancer and several independent variables. These variables included age, severity level, length of hospital stay, presence of other medical conditions, type of metastasis, treatment method, and discharge status. The equation for multiple linear regression can be expressed as:

$$Y_i = \beta_0 + \beta_1 X_{i,1} + \beta_2 X_{i,2} + \cdots + \beta_k X_{i,k} + \varepsilon_i \quad (1)$$

whereby Y_i is the i-th observation of the predicted variable which is the cost of one episode of treatment care. $X_{i,k}$ represents the independent variables. β_k are the regression coefficients representing the change in Y relative to a one-unit change in independent variables. ε_i is the model's random error term. The primary challenge in statistical models for healthcare expenses lies in dealing with skewed data (Lau *et al.* 2023; Majid *et al.* 2022; Malehi *et al.* 2015) and heteroscedasticity (Mazumdar *et al.* 2020). In order to compensate for the skewed distribution of hospital costs, a log transformation was applied in a regression model (Lau *et al.* 2023; Majid *et al.* 2022; Hwang *et al.* 2019; Malehi *et al.* 2015). The equation for the logarithmic transformation is presented below.

$$\ln Y_i = \beta_0 + \beta_1 X_{i,1} + \beta_2 X_{i,2} + \cdots + \beta_k X_{i,k} + \varepsilon_i \quad (2)$$

In this study, the dependent variable is the treatment cost of one episode of care for cervical cancer patients, and the independent variables are the patient's demographic and clinical characteristics. Age and length of hospital stay are quantitative independent variables, whereas cancer severity, comorbidities, type of metastasis, treatment type, and discharge status are categorical independent variables. The level of severity of cancer is categorised into three groups: minor, moderate, and severe. Comorbidities include hypertension, diabetes, hyperlipidemia, depression, kidney failure, heart disease, and liver disease. There are several types of metastasis, including those to the lungs, bones, lymph nodes, liver, large intestine, and brain. The treatment types include chemotherapy, radiotherapy and surgery. The category of discharge status is divided into four outcomes: return home, death, transfer to other facilities, and discharge against medical advice. We estimated the β and γ parameters using the ordinary least squares (OLS) method.

The statistical significance of each independent variable in the linear regression model was determined using stepwise regression. The statistical significance is assessed after each iteration, and the potential explanatory factors are incrementally added or subtracted. Forward selection starts with no variables and gradually adds one variable at a time. After each addition, the model is analysed to determine its statistical significance. It keeps the variables that are considered to have the highest statistical significance and continues the procedure until adding more variables no longer meaningfully enhances the model. Two ways to assess the overall adequacy of the model are R^2 and adjusted R^2. R^2 as a statistical metric that quantifies the

proportion of the variance in the dependent variable that can be accounted for by the independent variable (Hamilton 2015). The adjusted R^2 is a revised version of R^2 that is used to evaluate the significance of each model. A higher adjusted R^2 shows that the new input variables add value to the model, whereas a lower adjusted R^2 implies that they do not. It is necessary to conduct diagnostic tests to verify that the data acquired satisfies the assumptions of the linear model. The dependent and independent variables must be linearly related. This linearity can be confirmed using scatterplots, which should display a straight-line relationship. The independent variables need to be independence from one another. This can be checked using correlation matrices where correlation coefficients should ideally be below 0.8 and variance inflation factor (VIF), with value above 10 indicating multicollinearity. The error terms (residuals) should have a normal distribution and maintain constant variance across all levels of the independent variables. A scatterplot displaying the residuals plotted against the predicted values should exhibit no noticeable or distinguishable trend.

3. Results And Discussions

Table 1 displays the distribution of patients according to their age, severity level, and the number of comorbidities. The most common age group for cervical cancer is 50–65 years old, according to the Malaysian National Cancer Registry Report 2012–2016 (Ab Manan *et al.* 2019), which is in line with the findings cited above. In addition, the study conducted by Hailu and Mariam (2013) found that cervical cancer was less common among people under the age of 35. The age group between 35 and 65 years old had the greatest variance in cancer severity. Among the 533 people in the defined age range, those with lower and moderate-stage cancer were about twice as likely as those with severe stage.

Table 1: Patients' frequency based on independent variables

Number of patients (%)									
Age group	Less than 35 years old 11 (1.33)			Between 35 and 65 years old 533 (64.29)			65 years old and above 285 (34.38)		
Severity Level	Minor 5 (0.60)	Moderate 5 (0.60)	Severe 1 (0.12)	Minor 203 (24.49)	Moderate 211 (25.45)	Severe 119 (14.35)	Minor 106 (12.79)	Moderate 99 (11.94)	Severe 80 (9.65)
Number of comobidities									
0	5 (0.60)	5 (0.60)	0	164 (19.78)	164 (19.78)	56 (6.76)	66 (7.96)	47 (5.67)	16 (1.93)
1	0	0	1 (0.12)	20 (2.41)	31 (3.74)	41 (4.95)	19 (2.29)	26 (3.14)	21 (2.53)
2	0	0	0	11 (1.33)	10 (1.21)	11 (1.33)	12 (1.45)	16 (1.93)	16 (1.93)
3 and above	0	0	0	8 (0.97)	6 (0.72)	11 (1.33)	9 (1.09)	10 (1.21)	27 (3.26)

Furthermore, this study took into account the presence of comorbidities such as hypertension, diabetes, hyperlipidemia, depression, renal failure, heart disease, and liver disease as the primary variables influencing cervical cancer. This comorbid factor was chosen based on multiple prior studies that identified it as the most commonly reported comorbidity among cervical cancer patients (Sarawagi & Sharma 2022; Cofie *et al.* 2018; Constantinou *et al.* 2016; Austin *et al.* 2022; van der Aa *et al.* 2008; Shin *et al*. 2008; Subramanian *et al.* 2013). Out of the 829 samples collected, the majority of patients (63.09%) had no comorbidities.

Patients with one comorbidity had the highest incidence (19.20%), followed by those with two comorbidities (9.17%) and finally patients with three or more comorbidities (8.56%).

Table 2 displays the mean and standard deviation of treatment expenses for patients with cervical cancer categorised by severity, age group, and number of comorbidities. It shows that the mean expense of treating cervical cancer is rising in correlation with the degree of severity. The mean expense for minor severity treatment is approximately RM3,300, and this amount rises by RM1,000 for moderate severity. The cost of treating severe severity is, on average, double that of treating moderate severity and nearly three times that of treating light severity. In terms of age group, the treatment cost for patients between the ages of 35 and 65 is the lowest among cervical cancer patients diagnosed with minor severity. Conversely, patients between the ages of 35 and 65 incur the largest treatment costs compared to patients in the moderate and severe stages. The average cost of cervical cancer therapy for patients in the severe severity level was twice as high as the average cost for patients in the other two severity level groups, across all three age groups. The average cost of treatment for cervical cancer patients aged 35 to 65 with severe cancer severity and one comorbid factor is RM12170.71 ± 5835.68, which is the highest average cost of treatment. The second highest average treatment cost of RM9490.21 ± 5694.53 occurs within the same age group and cancer severity but without any cervical cancer comorbidities.

Table 2: Treatment costs according to severity level, age group and number of comorbidities

	Costs (RM) Mean ± Standard deviation								
Severity level	Minor 3214.61 ± 2091.70			Moderate 4333.19 ± 2653.73			Severe 9279.06 ± 5937.96		
	Age < 35	35 ≤ Age < 65	Age ≥ 65	Age < 35	35 ≤ Age < 65	Age ≥ 65	Age < 35	35 ≤ Age < 65	Age ≥ 65
Age group	3410.78 ± 2356.51	3066.29 ± 1460.53	3489.39 ± 2933.66	3541.76 ± 1213.68	4554.42 ± 2003.67	3901.66 ± 2911.43	8445.94 ± 0	10148.6 ± 5630.11	7996.03 ± 6217.42
Number of comobidities									
0	3410.78 ± 2356.51	2975.69 ± 1102.49	2839.12 ± 1378.42	3541.76 ± 1213.68	4741.90 ± 3095.96	3731.07 ± 1345.70	-	9490.21 ± 5694.53	9126.80 ± 8016.62
1	-	3723.05 ± 2711.87	3198.52 ± 1751.64	-	3997.73 ± 2165.86	3513.85 ± 1724.96	8445.94 ± 0	12170.71 ±5835.68	8177.03 ± 4929.01
2	-	3732.78 ± 2579.27	3055.21 ± 1528.32	-	3266.81 ± 1337.51	5025.73 ± 3496.81	-	8260.21 ± 2751.78	9176.64 ± 9198.85
3 and above	-	2365.30 ± 1050.47	9450.99 ± 6591.65	-	4452.15 ± 2402.01	3913.24 ± 1726.91	-	7851.83 ± 4793.37	6485.54 ± 2971.83

Table 3 displays the expenses associated with treating cervical cancer patients based on the specific comorbidity type. Hypertension is the most common comorbid type, affecting 196 individuals (23.64%), followed by diabetes in 127 patients (15.32%). In terms of the average treatment cost, individuals with renal failure have the highest average treatment cost (RM8986.45 ± 6279.45).

Table 3: Treatment costs according to type of comorbidity

Comobidity	Number of patients (%)	Costs (RM) Mean ± Standard deviation
Hypertension	196 (23.64%)	5339.05 ± 4263.09
Diabetes	127 (15.32%)	5495.21 ± 2755.81
Hyperlipidemia	73 (8.81%)	5306.98 ± 625.78
Depression	6 (0.72%)	7409.58 ± 5409.44
Renal failure	95 (11.46%)	8986.45 ± 6279.45
Heart disease	23 (2.77%)	5006.16 ± 5628.79
Liver disease	25 (3.01%)	6690.10 ± 3511.88

The results of the ANOVA and regression model are summarised in Table 4. The coefficient of determination, R^2, quantifies the proportion of the variance in the outcome variable that can be explained by the predictor variables. This model shows that the predictor variables can explain 46.31% of the variability in cervical cancer treatment costs. According to Ozili (2022), studies on human behaviour often have a low R^2 value due to its dynamic character. Ozili (2022) discovered that many independent variables, such as type of treatment, length of hospitalisation, and discharge status, are related to human behaviour. Furthermore, in social science studies, R^2 values between 0.1 and 0.5 have been considered acceptable when all independent variables show significance in connection to the dependent variable (Ozili 2022). Furthermore, the *p*-value of less than 0.001 gave additional support for the proposed model. These findings suggest that the null hypothesis may be rejected, and that this regression model is appropriate for usage. As a result, the model used in this study closely matched the data. Diagnostic tests are conducted to verify the assumptions established throughout the analysis and ensure that none of the regression assumptions were violated. Refer Figure 1.

Table 4: ANOVA result and model summary

Model	Sum of squared	df	Mean of squared	*F*	*p*-value
Regression	154.3620	12	12.8635	58.65	< 0.001
Residuals	178.9691	816	0.2193	-	-
Total	333.3311	828	-	-	-
R^2	0.4631				
Adjusted R^2	0.4552				
Residual standard error	0.4683				

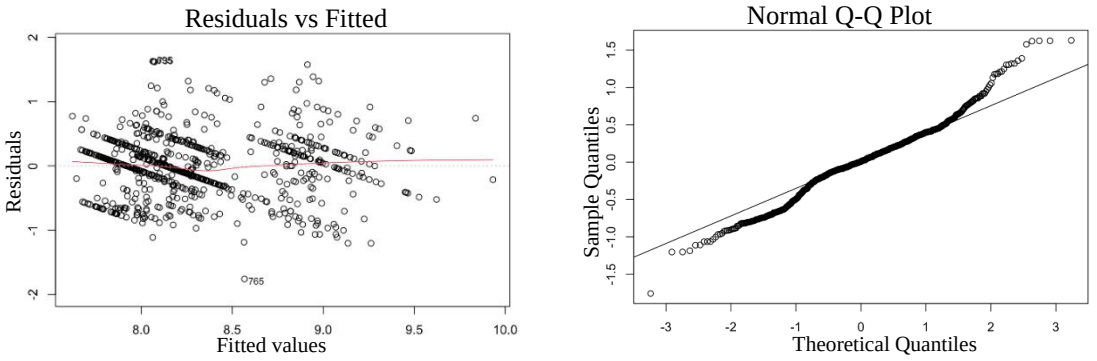

Figure 1: Diagnostic plots

Table 5 presents the parameter estimates of the multiple linear regression model that is best suited for predicting the cost of treatment for patients with cervical cancer. All variables in the

model exhibited substantial effects on the costs associated with the treatment of patients diagnosed with cervical cancer. The regression analysis was performed using the minor severity level as a reference group. The study investigates the coexistence of many medical conditions, such as hypertension, diabetes, hyperlipidemia, depression, and liver disease, alongside cervical cancer. These diseases are compared to a control group of cervical cancer patients who do not have any additional health problems. The reference group comprises cervical cancer patients without any metastases, including various types of lungs, liver, lymph, and colon metastases. In addition, the group of cervical cancer patients who had chemotherapy was combined with a control group of cervical cancer patients who did not receive any treatment. The cohort of cervical cancer patients who died was also combined with the reference group of other discharge statuses.

Table 5: Estimation of parameter for multiple linear regression model

Parameter	Independent variable	Estimation of coefficient (β)	Standard error	*t*	*p*-value
Intercept		8.3743	0.1152	72.699	< 0.001***
Age	X_1	-0.0050	0.0013	-3.817	< 0.001***
Length of hospital stay	X_2	0.0094	0.0018	5.369	< 0.001***
Severity (Reference: Minor)					
Moderate	X_3	0.2576	0.0402	6.402	< 0.001***
Severe	X_4	0.8331	0.0524	15.900	< 0.001***
Comorbities					
Renal failure	X_5	0.1086	0.0577	1.882	0.0601·
Heart disease	X_6	-0.2732	0.1027	-2.660	0.0080**
Metastasis (Reference: No metastasis and metastasis found in liver, lymph nodes, lungs, and colon)					
Brain metastasis	X_7	0.2722	0.1292	2.107	0.0355*
Bone metastasis	X_8	-0.1713	0.0738	-2.321	0.0205*
Treatment (Reference: No treatment and chemotherapy)					
Radiotherapy	X_9	-0.0919	0.0449	-2.045	0.0411*
Surgery	X_{10}	0.4871	0.1498	3.252	0.0012**
Other treatment	X_{11}	0.1352	0.0387	3.491	< 0.001***
Status of discharge (Reference: death, transfer to other facilities, and discharge against medical advice)					
Discharged to home	X_{12}	-0.2271	0.0784	-2.897	0.0039**

Note: ***, **, *, and · indicate that the parameter is significant at the significance levels of 0.001, 0.01, 0.05, and 0.1, respectively.

For a better understanding of the factors that contribute to the high cost of treating cervical cancer patients, the acquired model must be transformed from a log-linear to a linear form before it can be interpreted. This is the estimated equation that was obtained:

$$Y = e^{8.3743} \cdot e^{-0.005X_1} \cdot e^{0.0094X_2} \cdot e^{0.2576X_3} \cdot e^{0.8331X_4} \cdot e^{0.1086X_5} \cdot e^{-0.2732X_6} \cdot e^{0.2722X_7} \cdot e^{-0.1713X_8} \cdot e^{-0.0919X_9} \cdot e^{0.4871X_{10}} \cdot e^{0.1352X_{11}} \cdot e^{-0.2271X_{12}} \quad (3)$$

Assuming all other variables remain constant, a one-unit increase in X_i will have a multiplicative effect on the cost of treating cervical cancer patients, leading to an increase of e^{β_i} for positive β_i and a decrease of e^{β_i} for negative β_i. Costs associated with treating cervical cancer patients are expected to increase as shown in Table 6 for factors such as length of hospital stay, severity of disease, presence of kidney failure, brain metastases, surgery, and other treatments. For patients with cervical cancer, for instance, a one-day increase in hospitalisation duration results in a 0.9% rise in treatment costs. The baseline cost of RM4334.23 can be

interpreted as the cost of cervical cancer treatment for a patient in the reference group. If a subject has any of the characteristics or complications specified in Table 6, the cost can be estimated using the product of the baseline cost and the multipliers for each. The estimated treatment cost for a patient with moderate severity is RM5608.49 (RM4334.23 ×1.294). For a patient with severe cancer severity, brain metastasis and treated with surgery, the treatment cost estimated to be RM21308.80 (RM4334.23 × 2.300 ×1.313 × 1.628).

The cost of treating cervical cancer patients is reduced by factors such as age, the presence of heart disease or bone metastases, and the use of radiation therapy. When a patient is able to return home after being discharged, it helps to lower the costs of their treatment. For individuals suffering from cardiovascular disease, for instance, there will be a 23.9% reduction in treatment expenses. Hence, cervical cancer patients can utilise the acquired model to estimate their treatment costs according to their individual characteristics. Costs associated with cervical cancer therapy varied significantly according to the patient's age, according to this study. As a patient's age grows by one unit, the cost of treating cervical cancer falls by 0.5%. Singh *et al.* (2020) and Cromwell *et al.* (2016), who also discovered that age significantly affected treatment costs, corroborate the findings of this study. While one study in India (Singh *et al.* 2020) indicated that cervical cancer treatment costs decrease with age, another in Columbia (Cromwell *et al.* 2016) found the opposite to be true: that treatment costs rise with age. Although this study was carried out in Asia, taking into account demographic characteristics that are more common among Asian countries' populations, the findings are nonetheless corroborated by Singh *et al.* (2020).

Table 6: The treatment costs associated with demografic and clinical variables

Model		Baseline cost		RM4334.23
		Estimation of coefficient (β_i)	Multiplier (e^{β_i})	Change on Y (%)
Age	β_1	-0.0050	0.995	-0.5
Length of hospital stay	β_2	0.0094	1.009	0.9
Moderate	β_3	0.2576	1.294	29.4
Severe	β_4	0.8331	2.300	130.0
Renal failure	β_5	0.1086	1.115	11.5
Heart disease	β_6	-0.2732	0.761	-23.9
Brain metastasis	β_7	0.2722	1.313	31.3
Bone metastasis	β_8	-0.1713	0.843	-15.7
Radiotherapy	β_9	-0.0919	0.912	-8.8
Surgery	β_{10}	0.4871	1.628	62.8
Other treatment	β_{11}	0.1352	1.145	14.5
Discharged to home	β_{12}	-0.2271	0.797	-20.3

Furthermore, this study found that the duration of hospitalisation plays a substantial role in establishing the expense of cervical cancer treatment. A one-day increase in hospital stay will lead to a 0.9% rise in treatment expenditures. This study's findings that hospital stays for treatments like radiation and chemotherapy add time to treatment and money to the total cost of care are in line with those of Berg and Chattopadhyay (2004) and Ameri *et al.* (2022). Also, the study discovered that the cost of treating cervical cancer patients was significantly impacted by the severity degree of the patient. When comparing minor cervical cancer to a moderate or severe diagnosis, the treatment costs for the former will increase by 29.4% and for the latter by 130%. Studies by Wolstenholme and Whynes (1998) and Bennett and Calhoun (2007) support the findings of this study, which suggest that the expense of treating cervical cancer patients increases with severity. They stated that intermediate and severe cases require sophisticated

treatment, while minor cases do not. Contrarily, Hailu and Mariam (2013) and Nelson *et al*. (2016) found that treatment costs for severe levels are lower than those for minor and moderate levels. According to them, the limited availability of therapy options contributes to a higher mortality rate among individuals diagnosed at a severe stage.

Additionally, the study highlights the major impact of renal failure and cardiovascular illness as comorbidities on the expense of cervical cancer treatment. Treatment expenses will rise by 11.5% for cervical cancer patients who also have kidney failure. These findings corroborate those of Subramanian *et al.* (2013), who found that the average treatment cost for cervical cancer patients with comorbidities is higher than the patients without such issues. Contrarily, this study found that patients with cervical cancer and heart disease will experience a 23.9% decrease in treatment expenditures. Treatment options for cervical cancer patients impact the findings of this study. Of the 23 cervical cancer patients with heart problems included in this study, 22 of them did not undergo hospital treatment, which further decreased treatment expenses. Treatment costs for cervical cancer are also significantly affected by patients who develop metastases to the brain and bones. The expense of treating cervical cancer patients who have spread to the brain will increase by 31.3%. The results of this study are consistent with those of Wu *et al.* (2018), who found that treatment costs are higher for patients with metastasis than for other patients. The cost of treatment will decrease by 15.7%, nevertheless, for cervical cancer patients whose cancer cells has spread to their bones.

Patients with cervical cancer who have radiation, surgery, and other treatments significantly affect the overall cost of cervical cancer treatment, according to this study. Combined with a control group that did not undergo treatment, this study found that chemotherapy had no discernible impact on the overall expense of cervical cancer care. Patients with cervical cancer who underwent radiation therapy will experience a reduction of 8.8% in treatment costs than those in the control group who underwent chemotherapy alone. This study's findings corroborate those of Granados-García *et al.* (2019), who also discovered that radiotherapy significantly contributes to the expense of cervical cancer treatment. Conversely, surgical procedures for cervical cancer patients will add 62.8% to the total cost of care. Blanco *et al.* (2021) discovered that cervical cancer patients who had surgery had to pay more for their treatment, which is in line with the findings of this study. The next factor is that the expense of therapy will rise by 14.5% for cervical cancer patients who choose for alternative treatments. Although these additional procedures are not actual treatments for cervical cancer, they are essential prerequisites for the cancer diagnosis and therapy. This study's findings support those of Singh *et al.* (2020), which found that the expense of treating cervical cancer will rise if patients have more treatments. Comorbid conditions such depression, high cholesterol, diabetes, or hypertension did not significantly affect the total cost of cervical cancer treatment in this study. There are non-significant sub-categories of predictor variables, such as liver, lymph node, lung, and colon metastases, chemotherapy treatment, and discharge status. This could be attributed to the limited amount of data available for certain levels of the sub-categorical variables. Hence, pruning the non-significant variables can be achieved by reducing the number of subcategories in the model. In general, patients will receive multiple treatments, either as an outpatient or during their stay as an inpatient. One additional constraint of the study's data is its exclusive reliance on hospital inpatient data, which only examines a single treatment episode rather than the overall expenses of cancer care therapy following diagnosis.

4. Conclusions

The information provided in this study present a measure of the burden on teaching hospital systems associated with the treatment of cervical cancer, as well as the factors impacting cervical cancer-related hospitalisation costs. To summarise, the cost of cervical cancer therapy per admission varies greatly based on the length of stay, severity level, metastasis, comorbidities, treatment modality, and discharge status. The cost of treatment incurred by cervical cancer patients increases along with the length of the patient's hospitalization. Besides, treatment costs increase significantly with severity level. Patients with severe cancer severity incurs the highest costs, followed by those with moderate severity and minor. Comorbid types such as kidney failure and types of brain metastasis will also increase the cost of treating cervical cancer patients. In addition, types of treatment such as radiotherapy will reduce the cost of treating cervical cancer patients compared to the group of patients who receive chemotherapy or do not receive any treatment. Other than that, the treatment cost for patients who receive surgery and other treatments will increase. This analysis provides data that will be valuable for future research into the cost and effectiveness of cervical cancer care.

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