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Cost-Effectiveness Analysis on the Treatment of Dengue Fever in Inpatients

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ABSTRACT

Dengue Hemorrhagic Fever (DHF) is still a global public health problem, especially in tropical regions, including Indonesia. Correlation between length of stay (LOS) with the cost of hospitalization was significant. Due to the limited government budget available, it is necessary to choose the use of drugs by taking into account quality and cost control. The purpose was to evaluate the cost-effectiveness of class rooms inpatients for reduction LOS. The research design was cost-effectiveness analysis by retrospective study in Private Hospital X in Sidoarjo, Indonesia, for DHF inpatients. The research was conducted at the Inpatient Installation of Private Hospital X, By Pass Krian, Sidoarjo in January-December 2020. The variables were LOS and cost of treatment in the hospital. The study sample was inpatients with mild DHF without comorbid disease. In this study using purposive sampling technique. This study involved 332 subjects. The class I and II trade off with class 3 in clinical outcomes in the form of length of hospitalization (Quadran I). The highest cost was in class I (IDR 3,289,599) compared to class II (IDR 2,985,496) and III (2,985,496). And there was significant difference between the three classes. The lowest length of stay was in class I (4.58 days) compared to class II (4.76 days) and class III (4.8 days). Although there was no significant relationship between the length of hospitalization (LOS). Therefore, it was necessary to further pharmacoeconomic analysis in other DHF therapies including the DHF vaccine.

1. INTRODUCTION

Dengue Hemorrhagic Fever (DHF) is an acute viral infection disease caused by dengue virus which is characterized by a fever of 2-7 days accompanied by bleeding manifestations, decreased platelets (thrombocytopenia), hemoconcentration marked by plasma leakage (increased hematocrit, ascites, pleural effusion, hypoalbuminemia) [1], [2]. The disease is transmitted through the bite of the Aedes mosquito which contains the dengue virus [1], [3]. Indonesia, which has a tropical climate, is very suitable for the

development of vector-borne diseases, including dengue. DHF cases in Indonesia were 204,171 cases in 2017 [4]. Java Island contributed the highest average number of dengue hemorrhagic fever cases each year. Dengue prevention and control programs have been in place on a national scale by the Ministry of Health (MoH) of Indonesia through the Directorate General for Communicable Diseases Control since 1968 [5]. Dengue Hemorrhagic Fever is still a global public health problem, especially in tropical and subtropical regions, including Indonesia as one of the endemic countries for DHF. In Indonesia, cases of DHF fluctuate every year and tend to increase the morbidity rate and the distribution of the affected area is getting wider. DHF outbreaks occur almost every year in different places and their occurrence is difficult to predict [6], [7]. The high incidence of dengue fever can cause an increase in the budget for health costs, especially the cost of drugs and medical consumables during hospitalization. Due to the limited government budget available, it is necessary to choose the use of drugs by taking into account quality and cost control, as well as studies of pharmacoeconomic aspects in the selection and use of drugs effectively and efficiently in analyzing drug costs [8- 11].

Medical costs incurred in the National Health Insurance or Jaminan Kesehatan Nasional (JKN) era are something that needs to be considered because the determination of the riil cost of the hospital is intended so that the hospital does not suffer losses for every action given by the hospital to the patient which includes operational costs, maintenance, development and improvement of service quality. which exists. The riil costs also include hospital service rates such as hospital services, medical services, medical services, laboratory tests, anesthesia, use of medical materials and devices, so that it is hoped that a balance will occur between increasing riil costs and increasing services received by patients and the patient's ability to pay these costs [12], [13]. The highest drug cost in 2015 and 2016 in DHF patients with BPJS insurance and non-BPJS insurance were US$113.82; US$44.34 and US$108.2; US$106.84. Correlation between several drugs with drug cost was significant. The highest hospitalization costs in 2015 and 2016 in DHF patients with BPJS insurance and non-BPJS insurance were US$199.26; US$249.6. and US$251.29; US$318.83. Correlation between LOS with the cost of hospitalization was significant [14].

Health economic research specific to dengue is urgently needed to ensure informed decision making on the various options for controlling and preventing this disease—an option, which in the not too distant future, is likely to include vaccination [15-17]. One of the pharmacoeconomic studies is the analysis of the cost effectiveness and effectiveness of alternative treatments according to the Average Cost Effectiveness Ratio (ACER) and Incremental Cost Effectiveness Ratio (ICER) per therapy [18], [19]. The Private Hospital in Sidoarjo was a referral hospital in Krian, Sidoarjo, Indonesia which was included in the treatment of Dengue Fever, where data on the top 10 diseases claimed for treatment costs by BPJS states that dengue fever occupies the 3rd position, which means that many local people suffer from dengue fever and use it. the government's JKN system. In this study, an assessment of the impact of treatment and the calculation of the average riil cost of direct medical treatment was carried out, so the purpose of this study was to determine whether there was a difference from the riil costs incurred by the Hospital for Dengue Fever Patients participating in JKN-BPJS, with the riil costs received. Hospital according to the rates of the JKN-BPJS INA CBG's package and what are the components that affect it. So it can be considered in the selection of dengue fever therapy by taking into account the quality and the hospital. The purpose of this study was to evaluate the cost-effectiveness of class rooms inpatients for reduction long hospital stay.

2. METHODS

2.1 Research design

The research design used in this study was a retrospective study by taking data the patient's medical record

in Private Hospital X in Sidoarjo for dengue fever inpatients. The research was conducted at the Inpatient Installation of Private Hospital X, By Pass Krian, Sidoarjo in the period from January-December 2020. The dependent variables in this study were the length of stay and the cost of treatment in the hospital.

2.2 Population And Sample

The population in this study were DHF inpatients, were hospitalized at the X Private Hospital in Sidoarjo. The study sample was inpatients with mild DHF without comorbid disease. In this study using purposive sampling technique.

2.3 Cost

The costs analyzed in this study were costs during treatment at the hospital, including hospitalization costs, drug costs, medical equipment costs, and medical personnel costs. The cost of treatment between classes I, II, and III only differs in the cost of hospitalization, included: drug costs, hospital service fees, doctor's service/consultation fees and inpatient room costs (including nurse fees and consumption costs). This study used a hospital perspective, which was composed of direct costs, such as the cost of medicine, medical measures, the services of medical personnel, and equipment costs related to the therapy. Indirect costs and the intangible cost was not counted in this study because it uses a research perspective hospital to be observed during the treatment of asthma patients to get treatment at the hospital.

2.4 Outcome

The outcome of this study was the length of hospitalization.

2.5 Data analysis

The method of the CEA (Cost-Effectiveness Analysis) will be calculated:

a. Cost analysis Determine the ratio between the cost of the treatment given to the subject of research. Costs were observed originating from the hospital perspective, namely direct costs include nurse service costs, the cost of physician services, the cost of medical equipment, as well as the cost of drugs.

b. ACER (Average Cost-Effectiveness Ratio). ACER was the ratio of the cost-effectiveness/benefit (effectiveness) of the treatment given to the subject of research.

The data on the characteristics of the two groups will be tested for homogeneity with chi-square test and if the P value> 0.05 means that the data was no difference between the two groups. Outcomes in the form of the length of hospitalization. Both groups were tested differently by chi-square test and if H0 was rejected when p <0.05 and if there wasn't a difference between the two groups.

3. RESULTS

3.1 Characteristics of Research Subjects

This study involved 332 subjects who were divided based on their inpatient class. Most of the respondents were male, and aged in the range of 14-28 years (Table 1).

Table 1: Frequency Distribution of DHF Inpatients

Characteristic Baseline		Class I (n: 59)		Class II (n: 140)		Class III (n: 133)	
		Frequency	Percentage (%)	Frequency	Percentage (%)	Frequency	Percentage (%)
Gender	Male	34	57.63	76	54.29	73	54.89
	Female	25	42.37	64	45.71	60	45.11
Age (years)	0-13	8	13.56	33	23.57	13	9.77
	14-28	32	54.24	63	45.00	83	62.41

29-43	11	18.64	36	25.71	19	14.29
44-58	7	11.86	8	5.71	14	10.53
59-80	1	1.69	0	0.00	4	3.01

Source: Data for Case Mix The Private Hospital, Sidoarjo

3.2 Cost

In this study, it was also known that several cost components affect the (riil) costs incurred during the treatment of DHF. The health services rate at Private Hospital X in Sidoarjo city included four categories, namely action, medical personnel, medicines & others, and supporting facilities. Some of the sub-categories of these costs can be seen in the table of cost components for patients with Mild DHF which are grouped by treatment class. The highest total cost was class 1 with the biggest difference in costs being in medical action and room costs (Table 2).

Table 2: Details of Treatment Costs for DHF Patients Based on Inpatient Room Class

Cost Type		Class I (n: 59)		Class II (n: 140)		Class III (n: 133)	
		Frequency	SD	Frequency	SD	Frequency	SD
Medical action	Non-surgical Procedure	2,644,737	1,596,035.29	2,518,795	1,220,987.08	2,240,684	1,244,844.76
,Medical personnel	Consulting	76,822	147,847.22	56,482	135,082.87	81,880	159,925.53
	Expert	7,119	12,872.16	4,929	11,155.95	6,541	12,434.38
	Nursing	82,576	176,801.88	56,150	133,637.16	65,346	127,440.54
Medicine & others	Medicine	44,220	96,563.93	48,415	119,996.26	71,394	153,163.78
	Medical device	46,455	88,886.05	38,259	99,537.93	51,837	102,750.92
	Consumable medical expenses	16,669	40,036.8	9,224	24,918.02	20,205	43,357.31
Supporting facilities	Equipment Rental	4,034	7,294.23	4,043	18,478.40	3,707	7,046.15
	Rom	284,322	556,600.25	184,821	442,246.31	215,977	420,872.77
	Support	3,458	18,617.12	1,457	12,147.40	3,835	19,474.99
	Radiology	3,898	20,989.90	2,464	16,712.73	10,414	56,040.59
	Laboratory	75,288	158,379.95	60,457	148,813.50	86,632	180,752.99
Total Cost		3,289,599	96,1545.49	2,985,496	770,641.58	2,858,451	761,801.52

Source: Data for Case Mix The Private Hospital, Sidoarjo

In table 2, the normality test was carried out on the cost data for class I (P=0.06), class II (P=0.07), and class III (P=0.1), so it can be concluded that all data are normally distributed and continue with the ANOVA test. The test results showed that the P value <0.05 between classes I, II, and III, which means there was a significant difference between the three classes of inpatient rooms.

3.3 Outcome

The highest LOS outcomes in this study were 4-5 days in the three classes (Table 3).

Table 3: Outcome for DHF Patients Based on Inpatient Room Class

LOS (days)	Class I (n: 59)		Class II (n: 140)		Class III (n: 133)	
	Frequency	Percentage(%)	Frequency	Percentage(%)	Frequency	Percentage(%)
2-3	11	18.64	19	13.57	20	15.04
4-5	36	61.02	88	62.86	76	57.14
6-7	11	18.64	28	20.00	33	24.81
8-9	1	1.69	5	3.57	4	3.01

Source: Data for Case Mix The Private Hospital, Sidoarjo

3.4 Pharmacoeconomic Analysis

Pharmacoeconomic analysis used in calculating the results of this pharmacoeconomic research is to use

ACER (Average Cost-Effectiveness Ratio) calculations. where the average hospital cost will be compared with the average length of therapy given/Length of Stay (LOS).

Table 4: Calculation of ACER

	Class I (n: 59)	Class II (n: 140)	Class III (n: 133)
Average Cost (IDR)	3.289.599	2.985.496	C
Average LOS (Days)	4.58	4.76	4.8
ACER	718.253	627.205	595.511

Source: Data for Case Mix The Private Hospital, Sidoarjo

On the effectiveness of dengue fever therapy with ACER calculations based on the average cost compared to the average LOS for effectiveness. the data obtained for class I group was 4.58 days with repairs requiring an average cost of Rp. 3,289,599. for the class 2 group of 4.76 days requires an average cost of Rp. 2,985,496. while for class 3 of 4.8 days requires an average cost of Rp. 2,858,451. The ACER value for class 3 is smaller than the class 2 and class 1 groups. This ACER value illustrates that the ratio of costs per patient compared to the effectiveness of therapy shows more effective and efficient treatment outcomes (Table 4).

In the normality test with chi square, a P value of 0.856 was obtained so that data obtained that there was no significant relationship between the length of hospitalization (LOS) and the existing treatment class so that it could also be interpreted that the LOS did not have a correlation with the type of treatment class. In this pharmacoeconomic analysis to see the effectiveness of fever therapy. For mild DHF, ACER (Average Cost-Effectiveness Ratio) was calculated, where the average hospital cost will be compared with the average LOS then an analysis was carried out using a cost-effectiveness plane which will be known in what quadrant for ACER calculations. So that it can be concluded how the cost-effectiveness of treating mild DHF has been so far. In class III it was known that it has the lowest ACER value, which was 595,511 compared to with class II which was 627,205 and class 1 which was 718,253, so that in the cost-effectiveness plane quadrant image, class III becomes the reference at the axis point (0,0) and in the quadrant image it looks like class I and class II were located in quadrant 1, which was with higher effectiveness. but the cost was higher when compared to class III. So it can be concluded that class I and II trade off with class 3 in clinical outcomes in the form of length of hospitalization (Quadran I).

4. DISCUSSION

The National Health Insurance (Jaminan Kesehatan Nasional/ JKN) is a government program contained in the National Social Security System (Sistem Jaminan Sosial Nasional/ SJSN) program and is an implementation of Universal Health Coverage. JKN aims to guarantee health care benefits and financial protection for its participants in terms of promotion. preventive. curative. and rehabilitative services including medicine and medical consumables according to medical needs in Indonesia. JKN is part of SJSN which is administered through a mandatory Social Health Insurance mechanism in accordance with Law No. 40/2004 concerning the SJSN. The goal is that all Indonesian residents are protected in the insurance system. so that they can meet the basic needs of proper public health [20], [21]. The method of payment for the SJSN for JKN participants is a monthly fee paid by the participants. but for participants who are less able, the contribution will be paid by the government [20]. The definition of Social Security Administering Body (Badan Penyelenggara Jaminan Sosial/ BPJS) according to Law Number 24/2011 Article 02 is a public legal entity that is responsible to the President and has the function of administering a health insurance program for all Indonesian residents including foreigners who work for a minimum of 6 (six) months in Indonesia. Indonesia. The SJSN organized by BPJS is based on humanitarian principles. benefit. social justice for all the people of Indonesia. Meanwhile, the BPJS target is to ensure that every process in

health services is carried out efficiently. effective continuously and of high quality [22]. According to the Regulation of the Minister of Health Number 27/2014 concerning Technical Guidelines. INA-CBG's system. casemix system is a grouping of diagnoses and procedures with reference to similar/same clinical features and similar/same treatment costs. Grouping is done using a grouper. The casemix system was first developed in Indonesia in 2006 under the name INA-DRG (Indonesia-Diagnosis Related Group) [23].

Length of stay was assessed by extracting the duration of hospital stay measured in hours or days. In this study, the highest length of stay (LOS) for mild dengue fever was 4-5 days for class 1 (61%), class 2 (62.86%) and class 3 (57.14%) (Table 3). Fever and thrombocytopenia were the most common presentation of dengue fever (DF). The overall mortality of DF is low, if treated appropriately. Awareness of health care professionals and public regarding preventive strategies is essential to fight against this disease [24], [25]. Previous research by [26], was not much different from the patients with moderate (38.1%) and mild (21.9%) thrombocytopenia who were treated for an average of 4.13 days and 4.08 days, respectively. The analysis of correlation obtained a significant relationship between thrombocytopenia and length of hospitalization despite showing a weak correlation (r=0.231, p=0.001). In conclusion, there was a weak correlation between thrombocytopenia and length of hospitalization among dengue child patients. Furthermore, the average length of hospitalization of dengue patients based on the degree of thrombocytopenia showed that patients with mild thrombocytopenia underwent hospitalization for an average of 4.08 days. Whereas in patients with moderate and severe thrombocytopenia underwent hospitalization for an average of 4.13 days and 4.84 days respectively. The length of hospitalization represents the time in a treatment period that was calculated by the subtraction of the date of discharge and the date of admission the patient was hospitalized.

In Indonesia, DHF treatment was more on drug therapy, not vaccines. Therefore, research related to vaccine therapy need to be developed. Previous research in Indonesia [27], aimed to analyse the cost-effectiveness of dengue vaccination in Indonesia whilst taking *Wolbachia* and health education programs. An age-structured decision tree model was developed to assess the cost-effectiveness. Approximately 4,701,100 children were followed-up in a 10-year time horizon within a 1-year analytical cycle. The research compared three vaccination strategies: one focusing on vaccination only, another combining vaccination and a *Wolbachia* program, and a third scenario combining vaccination and health education. All scenarios were compared with a no-intervention strategy. It concluded that vaccination combined with a *Wolbachia* program was confirmed to be the most cost-effective intervention. The most influential parameters affecting the ICERs were probability of DENV (dengue virus) infection, vaccine efficacy, under-reporting factor, vaccine price, case fatality rate and screening cost. It concluded that dengue vaccination and pre-vaccination screening would be cost-effective to be implemented in Indonesia. Nevertheless, it seems unaffordable to be implemented since the total required cost for the nationwide vaccination would be 94.44% of routine immunization budget [28].

Based on the results of the study, suggestions can be proposed for further detailed pharmacoeconomic studies related to the difference between the riil costs and the costs of INA CBG's [29], [30]. In addition, it is necessary to analyze standard therapy / clinical pathways to determine the efficiency of dengue fever treatment [31], [32].

5. CONCLUSION

Based on the results of research conducted on 332 DHF inpatients, it can be concluded that class I and II trade off with class 3 in clinical outcomes in the form of length of hospitalization (Quadran I). The highest cost was in class I (IDR 3,289,599) compared to class II (IDR 2,985,496) and III (2,985,496). And there

was a significant difference between the three classes of inpatient rooms. The lowest length of stay was in class I (4.58 days) compared to class II (4.76 days) and class III (4.8 days). Although there was no significant relationship between the length of hospitalization (LOS).

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7. CONFLICT OF INTEREST

The authors have no conflicts of interest regarding this investigation.

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