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Original Article

COST-EFFECTIVENESS ANALYSIS OF PROLANIS OF TYPE 2 DIABETES MELLITUS PATIENTS ON THREE COMMUNITY HEALTH CENTERS IN BANDUNG, INDONESIA

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ABSTRACT

Objective: The purpose of this study was to compare the cost-effectiveness of T2DM patients in community health centers (*Pusat Kesehatan Masyarakat*, Puskesmas) of Rancaekek, Linggar, and Nanjungmekar.

Methods: The medicine was a combination of metformin and glimepiride; the outcome parameter was fasting glucose level, cost components were fee of BPJS class III and transportation cost with the patient's perspective. Pharmacoeconomic method was cost-effectiveness analysis. Respondents were given counseling about the importance of medicine consumption.

Results: There were 60 respondents, which met the inclusion criteria, then grouped by gender (male (15%) and female (85%)) and age (the highest incidence was the range from 56 to 65 y old, 36.67%). The average cost-effectiveness ratio of Prolanis in the Puskesmas of Rancaekek, Linggar, and Nanjungmekar was 1,073, 956 and 1,885 IDR per decreased glucose level, respectively. The statistical analysis of decreased blood glucose was 0.341 and the Prolanis cost was 0.399, which no difference between decreased blood glucose and Prolanis costs in the three Puskesmas.

Conclusions: The Prolanis of Linggar Puskesmas was the most cost-effective compared to the Rancaekek and Nanjungmekar Puskesmas.

Keywords: Puskesmas, Fasting glucose level, Cost component, Pharmacoeconomic analysis

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INTRODUCTION

Diabetes is associated with a significant clinical and economic burden in the world, including Indonesia. The global projection for diabetes was 438 million in 2025 [1]. Diabetes mellitus (DM) is a clinical syndrome with signs of hyperglycemia due to absolute and relative insulin deficiency. Deficiency of insulin, which release by pancreas β-cells, significantly interferes with carbohydrate, protein, and fat metabolism [2, 3]. Blood glucose levels are regulated by insulin as the main regulator of metabolic intermediaries [2]. Type 2 diabetes (T2DM), known as adult-onset diabetes, is characterized by high blood glucose levels, insulin resistance, and a relative lack of insulin [3].

The community health center (Pusat Kesehatan Masyarakat, Puskesmas) is a health service facility, which organizes first-level public and private health efforts, with preventive and promotive priorities to achieve the highest degree of public health. The Health Social Security Administering Agency (Badan Penyelenggara Jaminan Sosial, BPJS) implements a Disease Management Program (Program Pengelolaan Penyakit Kronis, Prolanis) to control T2DM. The Prolanis goal is to encourage diabetes patients to achieve optimal quality of life at an effective and rational cost [4]. Regulation No. 40 of 2004 article 24 mandates Health BPJS to control of quality and costs, which implemented by Prolanis [5].

The DM economic burden and its impact on a patient's life can be measured by economic analysis, which calculates the most cost-effective therapeutic option [1]. Pharmacoeconomic study using the Cost-Effectiveness Analysis (CEA) method was conducted to control cost-effectiveness [6, 7]. The purpose of this study was to determine the decreased fasting glucose levels and the cost-effectiveness of T2DM patients in the Puskesmas of Rancaekek, Linggar, and Nanjungmekar. This study compared the implementation of Prolanis in three Puskesmas.

MATERIALS AND METHODS

Subjects

The study was approved by the Health Research Ethics Committee of Dr. Hasan Sadikin Hospital, Indonesia, and was conducted accordingly to an approved method. The patients were undertaken for observation only after their informed consent. This study was a prospective observational study, T2DM patients were enrolled in the study for 3 mo from May to July 2019. The population in this study was 109 patients, but only 60 patients who willing to participating in the study. The sampling technique was total sampling [8]. This study compared the cost-effectiveness of Prolanis patients in the Rancaekek, Linggar, and Nanjungmekar Puskesmas, West Java, Indonesia.

The inclusion criteria were:

a. Patients participate in Prolanis activities and check-up routinely.

b. Prolanis patients with T2DM.

c. Patients receiving a combination of 500 mg metformin (three tablets per day) and 1 mg glimepiride (one tablet per day) [9].

d. Patients over 18 y old.

The exclusion criteria were:

a. The patient was not a Prolanis participant.

b. The patient less than 18 y old.

c. The T2DM Prolanis participant who did not want to participate in the study.

d. Patients with co-morbid conditions such as hypertension, hypothyroidism, dyslipidemia, coronary artery disease, and myocardial infarction.

Methods

Determination of outcome

The outcome as an indication of medication successful was fasting glucose levels for 3 mo.

Determine the cost component

a) Determination of perspective. The perspective of this study was the patient's perspective.

b) Determination of cost components. The cost components were fee of BPJS class III (25,500 IDR) [10] and transportation cost for every month. Transportation costs were obtained from interviews.

c) Pharmacoeconomic analysis. Cost-effectiveness analysis was evaluated in follow-up cases, which achieving glycemic control, i.e. fasting blood glucose<130 mg/dl [11]. The cost of health interventions was measured in monetary units (Indonesian Rupiah, IDR) and the intervention results were health indicators, both clinical and non-clinical (non-monetary). Data analysis was performed by calculating the Cost-Effectiveness Ratio (CER) with formula 1 and the cost-effectiveness table [12].

$$CER = \frac{Cost}{Effectiveness} = \frac{cost\ of\ treatment}{fasting\ glucose\ level} \ldots (1)$$

Statistical analysis

Data were presented as the mean±standard deviation (SD). Data were conducted to statistical analysis using the Kolmogorov-Smirnov test, followed by ANOVA for parametric analysis or Kruskal Wallis Test for non-parametric analysis.

RESULTS AND DISCUSSION

The Prolanis goal is to encourage participants with chronic diseases to achieve optimal quality of life with an indicator of 75% of registered participants visiting first-level health facilities having "good" results of specific tests for T2DM and hypertension according to the relevant clinical guidelines to prevent disease complications. The forms of Prolanis implementation include medical or educational consultation activities, home visit, reminder, club activities and health status monitoring [4].

The T2DM patients, which Prolanis participant at Rancaekek, Linggar, and Nanjungmekar Puskesmas were 49, 24, and 36 patients, respectively. Patients who met the inclusion criteria were 20 patients in each Puskesmas, then filled in the informed consent and given counseling about the importance of medicine consumption. The patient distribution based on gender (table 1) showed that female patients (85%) higher than men (15%). This result was similar to the results of Alghadir *et al.* (2012) [13] and Awad *et al.* (2013) [14]. Female have a higher risk of developing diabetes than men, due to insulin resistance [15].

This study targeted T2DM patients ranging from 18 y old, but patients who came to the Puskesmas and participated in Prolanis were over 45 y old. This was because the Puskesmas service time was limited, from 8.00-12.00, but the patients have to start queuing at 6.00. This limitation caused there were no T2DM patients with productive age, i.e. 18-45 y old. The patient distribution based on age (table 1) showed that T2DM was mostly affected the 56-65 y (36.67%), followed by the 46-55 y (35.00%) and over 65 y (28.33%). This was due to the decreased organs function, thereby the increased disease risk [16]. In the world, diabetic patients are range from 45 to 64 y [17], with 80% of these patients are living in low-and middle-income countries, such as Indonesia [1]. The elderly people affect T2DM due to decreased physiology in body function and decreased insulin secretion and resistance, so the ability of the body's function to control blood glucose is less than optimal [18].

Table 1: Distribution of type 2 diabetes mellitus patients

Variable	Puskesmas					
	Rancaekek		Linggar		Nanjungmekar	
	Patients	%	Patients	%	Patients	%
Gender						
Male	3	15	4	20	2	10
Female	17	85	16	80	18	90
Age (years)						
<45	0	0	0	0	0	0
46-55	3	15	8	40	10	50
56-65	9	45	7	35	6	30
≥ 65	8	40	5	25	4	20

BPJS fee cover health services, medicines, laboratory examinations, and administration. All the Prolanis patients (60 people) were given a combination of 500 mg metformin and 1 mg glimepiride [9, 19]. Metformin belongs to the biguanides group, suppresses hepatic glucose production, increases insulin sensitivity, increases glucose uptake, increases fatty acid oxidation, and decreases glucose absorption [20]. Glimepiride belongs to sulfonylurea group, stimulates the release of insulin from pancreatic β-cells [21]. The success of T2DM treatment was assessed by a decreased fasting glucose level. All patients were shown decreased fasting glucose levels, in the range of 21-36 mg/dL, with an average of 29.65±22.86 mg/dl (table 2).

The decreased fasting glucose levels in the three Puskesmas were normal distribution with *p* value>0.05 indicated there was no significant difference between the data and the standard normal. This showed that the data were normally distributed and homogeneous, so we conducted the parametric analysis, i.e. one-way ANOVA. The results showed the significance value based on the outcome of decreased fasting sugar levels was 0.341, i.e. there was no significant difference.

Table 2: The decreased fasting glucose levels

Decreased fasting glucose levels (mg/dl) at the puskesmas		
Rancaekek	**Linggar**	**Nanjungmekar**
32.15±26.03	21.35±17.20	35.45±22.76

The average cost at Puskesmas Nanjungmekar was higher than other Puskesmas, with a difference of 5,750±750 and 6,350±900 IDR (table 3). This was because of higher transportation cost, due to the distance between the patient's home and the Nanjungmekar Puskesmas was in the range of 6 to 8 km. The best CER was the Linggar Puskesmas (table 4). Cost analysis statistically assessed the overall cost in detail based on data with the normality test. The total cost normality test resulted in *p* value<0.05, which showed a significant difference. The data were not normally distributed and not homogeneous, so it is included in the non-parametric statistical analysis. In the non-parametric analysis, a Crucial Wallis test is performed. Asymptotic significance value of 0.339 showed there was no difference between the costs in the three Puskesmas.

Table 3: Patient cost expended

Average costs (IDR)	Patient cost expended (IDR) at the puskesmas		
	Rancaekek	Linggar	Nanjungmekar
BPJS fee	25,500	25,500	25,500
Transportation	9,000±2,876	8,400±1,765	14,750±3,612
Total	34,500±3,574	33,900±2,583	40,250±4,575

Table 4: Calculation of cost-effectiveness ratios

Prolanis at the puskesmas	Average cost (IDR)	Outcome (mg/dl)	CER
Rancaekek	34,500±3,574	32.15±26.03	1,073±213
Linggar	33,900±2,583	21.35±17.20	1,587±138
Nanjungmekar	40,250±4,575	35.45±22.76	1,173±187

The cost-effectiveness table was used to determine health interventions relative to other health interventions [22]. The Prolanis in the Linggar Puskesmas was the most cost-effective compared to the Rancaekek and Nanjungmekar Puskesmas (table 5). All patients were educated that the T2DM can be maintained through lifestyle modification, diet control, and control of overweight and obesity. The community education was needed for diabetes control, and disease management was needed to improve the quality of life of T2DM patients. The data of the quality of life of T2DM Prolanis patients who participated in the study could not be processed, because they were only obedient in laboratory examinations and medicines. The patients were not adherent in education, which was observed from the attendance data on Prolanis activities.

Table 5: Alternative groups based on cost-effectiveness

Cost-effectiveness	Lower cost	Same cost	Higher cost
Lower effectiveness	A (need ICER calculation)	B	Rancaekek to Linggar Nanjungmekar to Linggar Nanjungmekar to Rancaekek
Same effectiveness	D	E	F
Higher effectiveness	Rancaekek to Nanjungmekar Linggar to Nanjungmekar Linggar to Rancaekek	H	I (need ICER calculation)

CONCLUSION

The Prolanis of Linggar Puskesmas was the most cost-effective compared to the Rancaekek and Nanjungmekar Puskesmas.

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Nil

AUTHORS CONTRIBUTIONS

All the authors contributed equally.

CONFLICT OF INTERESTS

Declared none

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