

Technical Efficiency of Maternal and Child Health Program at Public Health Center in Indonesia

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Abstract—The limited availability of health resources in the high public demand requires the health programs and service providers, especially in Public Health Center (Puskesmas) to make efficiency. This study aims to provide information about the level of technical efficiency of Puskesmas in Indonesia in organizing the Maternal and Child Health (MCH) program. This study also tries to investigate several factors that contribute to the level of Puskesmas efficiency in organizing MCH programs.

This study was quantitative research with cross-sectional approach. This study used secondary data derived from Health Financing Research (Health Financing Research: RPK) in 2015 for Puskesmas level. The data analyzed by the non-parametric technique using DEAP software version 2.1 to obtain technical efficiency score of each Puskesmas. After getting the technical efficiency score, the researchers conducted multivariate analysis using Tobit Regression, with the dependent variable was technical efficiency score of MCH program and predictors were the category of public health development index, fiscal capacity index, financial management authority status (BLUD status), geographical status, and region category.

The technical efficiency of the MCH program at Puskesmas level was 0.81 ± 0.12 . The efficiency scores were affected by geographic areas-where urban Puskesmas were more efficient than rural and remote areas-and regional fiscal capacity-where Puskesmas in areas with high fiscal capacity were more efficient than Puskesmas in areas with medium and low fiscal capacity. Areas with geographic limitations require more considerable health resources to obtain the same output than areas with more comfortable geographic conditions.

Keywords—technical efficiency, data envelopment analysis, input-output

I. INTRODUCTION

One of the notes of the end of the Millennium Development Goals (MDGs) is the still high maternal mortality ratio in Indonesia. Although the achievement of the

maternal mortality ratio has shown progress, i.e. 390 per 100,000 live births in 1991 to 359 per 100,000 live births in Indonesia Demography and Health Survey (SDKI) 2012 [1], but until the end of MDGs, the achievement of the maternal mortality ratio has not met the target of 102 per 100,000 live births. In 2015, the maternal mortality ratio was reported at 305 per 100,000 live births [2]. Meanwhile, under-five mortality ratio during the 1991-2012 period reported dropped from 97 to 40 per 1,000 live births [1]. Until the end of the MDGs, the under-five mortality ratio achieved the target; 32 per 1,000 live births. The ASEAN secretariat office reported the Indonesia under-five mortality ratio at the end of the MDGs period was 26 per 1,000 live births [2].

Various programs have been undertaken to improve maternal and child health. The Ministry of Health seeks to enhance the achievement of antenatal and postpartum visits, increase the percentage of births attended by health workers, increase weight-bearing coverage of under-fives and other programs to encourage the achievement of maternal mortality ratio and under-five mortality ratio reduction targets. Puskesmas, as the spearhead of promotive and preventive efforts with a community approach, plays a critical role in decreasing maternal mortality ratio and under-five mortality ratio. Nevertheless, decision makers in the health sector face a challenge of balancing the high demand for health services with available resources.

The limited availability of health resources in the high public demand circumstances requires the providers of health programs and services, especially in Puskesmas to conduct efficiency. The efficiency concept is based on the ratio of output (y) to the input (x) of the production process. Thus, efficiency can be interpreted as producing maximum output from existing inputs or produce specific outputs with minimal inputs [3]. An intervention or program is technically inefficient if equal (or more) results can be provided with fewer inputs [4].

Efficiency in the health sector refers to the physical relationship between resources (capital and labor) and health outcomes. Efficiency in the health sector tells about whether the use of health resources meets the value-for-money principle. Health services can be seen as an intermediary process; health service becomes a means in achieving the goal of health status improvement. Efficiency relates to the relationship between input resources (cost in the form of labor, capital, or equipment), intermediate output (number treated, waiting time, etc.) or health outcomes (surviving lives, increasing life expectancy, etc.) [5].

Currently, decision-makers in health services face the challenge of concocting requests for health services that society needs with available funds. Economists argue that achieving the efficiency of limited resources should be a key criterion in the priority setting process. Data Envelopment Analysis (DEA) is a simplified analysis used in developed countries to evaluate the efficiency of health service providers [6]. Understanding of how technically efficient a Decision-Making Unit (DMU) is –in this case, are health service providers (Puskesmas)– in managing available resources to meet the health outcomes is necessary to understand the extent to which the management of the MCH program runs well in Indonesia.

This study aims to provide information about the level of technical efficiency of Puskesmas in Indonesia in organizing the MCH program. This study was conducted using Data Envelopment Analysis (DEA) technique using data from Health Financing Research (RPK) in 2015. This study also tries to investigate factors that contribute to the level of Puskesmas efficiency in organizing MCH programs.

II. METHOD

This study was quantitative research with cross-sectional approach. To achieve the goal, researchers proceed to secondary data to obtain the level of efficiency and affecting factors. This study was a national level analysis of Health Financing Research (RPK) in 2015. The subject of this study were data on MCH program achievement and other related public health center data.

The data were analyzed by a non-parametric using the DEAP software version 2.1 [7] to obtain the technical efficiency score of each Puskesmas. The input variables involved in this study were the budget amount of the MCH program, the number of MCH program supporting rooms, the number of health personnel, and the number of community-based programs related to MCH. The output variables involved are the number of first antenatal care (K1), the number of fourth antenatal care (K4), the number of deliveries by health personnel, and the number of toddlers immunized. There were 305 Puskesmas (from 71 districts/ cities that were the sample of RPK 2015) involved in this study. However, the researchers removed as many as 11 Puskesmas from the analysis because they had missing values. Therefore, the Puskesmas engaged in this study were 294 Puskesmas.

After obtaining the technical efficiency score of Puskesmas, the researchers conducted multivariate analysis using Tobit Regression with a technical efficiency score of MCH program as the dependent variable. Predictors were a category of public health development index, fiscal capacity index, financial management authority status (BLUD status),

geographical status, and region category. Tobit regression was deliberately chosen because of the dependent variable, i.e., the technical efficiency score has a limited value, which is a maximum of 1 or 100% [8]. Multivariate analysis was performed using STATA software version 13.0.

III. RESULT

As explained in the research method, to obtain the technical efficiency score of MCH program, the researcher conducted data envelopment analysis (DEA). DEA technique was performed using Variable Return to Scale (VRS) or also called Barnes, Charnes, and Cooper Model (BCC; 1984) - Input Oriented DEA [9]. The use of this analysis was based on several reasons, i.e.: (a) answering the limitations of constant return to scale (CRS) assumptions by Charnes, Cooper, and Rhodes (CCR, 1978), (b) changes at all input levels will result in larger or smaller changes in output levels, and (c) not influenced by variation of input and output value, able to overcome 0 (zero) input and output or negative value.

Before performing analysis using DEAP version 2.1, firstly we conducted pre-analysis in order to fulfill DEA assumption; isotonicity –decreasing the efficiency along with the increase of input, and the increase of efficiency along with the increase of output [10]. It also means that an increase in the input will result in some increase in output [11]. Further Amponsah in 2017 assuming isotonicity, it is expected that an increase in input value (with other constant constants condition) should not reduce any output, but instead should be able to raise the value of at least one output [12]. To prove this assumption, correlation analysis of input and output variables was performed. The type of correlation used was determined based on the data normality test as follows.

TABLE I. NORMALITY TEST USING SHAPIRO-WILK TEST

Variable	Sample	W	V	Z-score	p-value
Number of 1 st antenatal care (K1)	294	0.84	34.32	8.29	<0.001*
Number of 4 th antenatal care (K4)	294	0.83	35.06	8.34	<0.001*
Number of deliveries by health professional	294	0.74	53.39	9.33	<0.001*
Number of toddlers immunized	294	0.78	45.99	8.98	<0.001*

^a. significant at p<0.05.

Based on the result of the Shapiro-Wilk test, it was known that all output variables have p-value <0.001. It can be concluded that the data were not normally distributed. Therefore, the correlation analysis used was Spearman correlation. Here are the results of Spearman's analysis that has been performed.

TABLE II. SPEARMAN CORRELATION TEST RESULT TO PROVE ISOTONICITY ASSUMPTION

Variable	MCH Program Budget	Number of MCH Supporting Rooms	Number of Health Personnel	Number of Community-based Programs Related to MCH
Number of 1 st antenatal care (K1)	0.10	0.02	0.29*	0.68*
Number of 4 th antenatal care (K4)	0.06	0.03	0.26*	0.70*
Number of deliveries by health professional	0.12*	0.02	0.27*	0.62*
Number of toddlers immunized	0.06	-0.01	0.28*	0.66*

*significant at $p < 0.05$.

The correlation analysis showed that the value of the correlation coefficient between input and output variables were positive, except the correlation coefficient of the number of MCH supporting rooms and the number of toddlers immunized. Amponsah in 2017 argued that to fulfill the isotonicity assumption, all inputs were expected to increase the value of at least one output [12]. Therefore, based on this analysis, the assumptions of isotonicity were met. Furthermore, we performed technical efficiency analysis using input and output with the DEA method. DEA results were presented in the following table.

TABLE III. MEAN OF TECHNICAL EFFICIENCY SCORE OF MCH PROGRAM BASED ON REGION

Region	Sample	Mean \pm SD	Min	Max
Sumatera	73	0.79 \pm 0.13	0.52	1.00
Java-Bali	107	0.82 \pm 0.13	0.47	1.00
Kalimantan	29	0.81 \pm 0.10	0.63	1.00
Sulawesi	41	0.85 \pm 0.11	0.63	1.00
Nusa Tenggara-Maluku-Papua	44	0.79 \pm 0.13	0.54	1.00
Indonesia	294	0.81 \pm 0.12	0.47	1.00

The results of the analysis showed that the average score of technical efficiency of the MCH program nationally was 0.81 or 81% with the lowest score of 47% and the highest 100%. By region, Puskesmas in Sumatera and Nusa Tenggara-Maluku-Papua had an average of technical efficiency achievements below the national score. The average technical efficiency score in Sumatra and Nusa Tenggara-Maluku-Papua was about 79%. However, the minimum score of the lowest technical efficiency score was at the Java-Bali, which is 47%.

To know the achievement score of technical efficiency of the MCH program in each region compared to the national average, the following table was the category of achievement score of technical efficiency based on national achievement.

TABLE IV. TECHNICAL EFFICIENCY OF MCH PROGRAM IN EACH REGION COMPARED TO NATIONAL AVERAGE

Region	Below National Average		Above National Average		Total	
	n	%	n	%	n	%
Sumatera	43	59.0	30	41.1	73	100
Java-Bali	49	45.8	58	54.2	107	100
Kalimantan	16	55.2	13	44.8	29	100
Sulawesi	16	39.0	25	61.0	41	100
Nusa Tenggara-Maluku-Papua	25	56.8	19	43.2	44	100
Indonesia	149	50.7	145	49.3	294	100

The result showed that Puskesmas that achieved technical efficiency score above the national average were almost comparable to those that have not reached the national average. The government had a burden because it was still heavy enough to improve the performance of Puskesmas since at least 50% of Puskesmas had scores below the national average in achieving technical efficiency of the MCH program. Based on regional, it was seen that more than 50% of Puskesmas in Sumatera, Kalimantan, and Nusa Tenggara-Maluku-Papua had not achieved average efficiency scores above national achievement. Java-Bali and Sulawesi had a more substantial proportion of Puskesmas compared to other regions in achieving technical efficiency of the MCH program. To know the factors that contributed to the achievement of technical efficiency score of each Puskesmas, we performed multivariate analysis using Tobit Regression. Here is the result of multivariate analysis using Tobit Regression.

Based on the table V of Tobit Regression analysis, it was known that variables that contributed to the achievement of technical efficiency of the MCH program were fiscal capacity index and region category. Puskesmas located in areas with high fiscal capacity index achieved higher technical efficiency score of KIA program compared to Puskesmas located in regions with low fiscal capacity index, so did the Puskesmas located in urban areas. Puskesmas located in urban areas were able to achieve higher technical efficiency score of MCH program compared to Puskesmas located in remote areas. The independent variables in this model were only able to explain about 12% of the dependent variables; the rest were explained by other variables outside of this model.

TABLE V. TOBIT REGRESSION ANALYSIS RESULT

Independent Variable	Coefficient	SE	t	p-value	95% CI		
Public Health Development Index							
Low	Reference Category						
Middle	0.012	0.032	0.38	0.707	-0.051	-	0.075
High	-0.006	0.036	-0.17	0.864	-0.077	-	0.064
Fiscal Capacity Index							
Low	Reference Category						
Middle	0.011	0.021	0.51	0.607	-0.030	-	0.052
High	0.064	0.024	2.67	0.008*	0.017	-	0.111
BLUD Status							
Non-BLUD	Reference Category						
BLUD	-0.0012	0.029	-0.04	0.966	-0.058	-	0.056
Geographical Status							
Aquatic	Reference Category						
Mountain	0.010	0.034	0.31	0.755	-0.056	-	0.077
Land	-0.009	0.031	-0.29	0.770	-0.071	-	0.053
Region Category							
Remote	Reference Category						
Rural	0.004	0.024	0.16	0.873	-0.044	-	0.051
Urban	0.079	0.029	2.73	0.007*	0.022	-	0.135
Constant	0.782	0.046	16.96	0.000	0.691	-	0.872

Multivariate analysis use Tobit Regression; simultaneous test $p=0.01$; Pseudo $R^2 = 0.12$
*significance at $p<0.05$

IV. DISCUSSION

There were several key findings from evaluating technical efficiency at the Puskesmas sampled in Health Financing Research 2015. Based on the efficiency scores obtained through the DEA method, Puskesmas on Sulawesi Island had the highest average level of technical efficiency, while Puskesmas in Sumatera, Nusa Tenggara, Maluku, and Papua had the lowest average of technical efficiency. Kalimantan was the third lowest efficiency level, and Java was the second highest after Sulawesi. This finding indicated that the geographical conditions of the region could influence the technical efficiency score. Puskesmas in archipelagic areas (Nusa Tenggara and Maluku) or mountainous areas (Papua, Sumatra, and Kalimantan) had relatively low of technical efficiency compared to Puskesmas in areas with relatively flatland geographical conditions (Sulawesi) or have a high density (Java). It can be supported by the findings in Table 7, where urban areas contribute to high levels of efficiency compared to rural and remote areas. This result can be attributed, one of them, to the ease of access in urban areas so that the number of antenatal visits and labor delivery rates was more accessible to obtain than in rural or remote areas where physical access (roads) was difficult or so far away.

The high fiscal capacity had an effect on the technical efficiency of the MCH program at the Puskesmas. Puskesmas in areas with high fiscal capacity were more efficient than regions with moderate and low fiscal capacity. Higher

efficiency in regions with greater fiscal capacity was a relatively new finding. Some studies that examined the impact of fiscal capacity on efficiency in the health sector stated that high fiscal capacity reduced the level of efficiency[13]. However, it needed a more in-depth exploration of how fiscal capacity influenced the efficiency of MCH programs in Puskesmas. In this case, it was a causal effect that directly bridges between the magnitude of fiscal capacity and efficiency or, because of the high fiscal capacity which easily achieved by large cities, then the influencing factor of efficiency was its urban environment rather than its direct fiscal capacity. Both of these findings indicated that the technical efficiency of the MCH program was very much related to the accessibility aspects of pregnant women to the Puskesmas and also access of Puskesmas to pregnant women.

V. CONCLUSION

The analysis showed that the average relative technical efficiency of the MCH program of Puskesmas obtained from Health Financing Research 2015 data was 0.81 with a standard deviation of 0.12. This range of values showed a variation in the level of efficiency of Puskesmas in Indonesia. Regionally, Puskesmas in Sumatra and Nusa Tenggara-Maluku-Papua have an average achievement of technical efficiency below the national level.

The results of the Tobit regression analysis indicated that efficiency scores were influenced by geographical areas – where Puskesmas in urban areas were more efficient than rural

and remote areas— and regional fiscal capacity – where Puskesmas in regions with high fiscal capacity were more efficient than Puskesmas in regions with medium and low fiscal capacity. This finding indicated that geographical barriers were the primary determinant of the efficiency of MCH programs at the Puskesmas.

The results of this analysis indicated that efficiency evaluation should consider differences in geographical conditions and fiscal capacity in each region. Geographically limited areas required more considerable health resources to obtain the same output than areas with more comfortable geographical conditions. Accessibility and availability of infrastructure was the major challenge for achieving equality and efficiency in the health sector.

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