

## TECHNICAL EFFICIENCY ASSESSMENT OF MATERNAL HEALTH SERVICES IN NEGERI SEMBILAN, MALAYSIA USING DATA ENVELOPMENT ANALYSIS

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### ABSTRACT

**Introduction:** Primary care is the first level of contact with the health system to promote health, prevent illness, care for common illnesses, and manage on-going health problems. Maternal health services were one of the important components of primary care delivered through health clinics and community clinics. It is crucial to ensure scarce resources in health clinic were utilized efficiently. Data envelop analysis is a technique which had advantage in assessment of efficiency of primary care because the technique can handle multiple inputs and outputs in efficiency score calculation.

**Objectives:** To assess technical efficiency of maternal health services and its determinants in primary care setting of health clinics in Negeri Sembilan using data envelopment analysis (DEA).

**Methodology:** This evaluation research employing cross-sectional study design using primary data from health district offices and health clinics in Negeri Sembilan. Sources of data include administrative records and expenditure records from district health offices, and maternal health services utilization obtained from clinic records. The study randomly selected 16 maternal health services of health clinics as DMUs. Data for 2016 and 2017 were used in the analysis. Analysis of DEA used two-stage DEA. In the first stage DEA to efficiency score, namely: overall technical efficiency (OTE), pure technical efficiency (PTE) and scale efficiency (SE) scores. In the second stage, four environmental variables namely location of health clinic, distance of health clinic to the nearest health facility, years of service of nurses and comorbidity of patient regressed against PTE score using Tobit regression analysis.

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**Results:** In 2016, average pure technical efficiency (PTE) for maternal health services were 60.50% (SD 35.50). An increased in mean PTE in 2017 for maternal health services with the score of 67.30% (SD 34.30). Maternal health services in type 2 health clinic were efficient as compared with other types of health clinic in 2016. In 2017, maternal health services in health clinic type 6 were efficient. One determinant was found to significantly affect TE (comorbidity of patient).

**Conclusion:** The findings from this study found that technical efficient maternal health services in Negeri Sembilan were in Health Clinic Type 5 (31.25%) and Health Clinic Type 6 (37.50%) in 2016 and 2017 respectively. Patients with more comorbidity significantly decrease technical efficiency of maternal health services.

**Keywords:** technical efficiency, maternal health, primary care service, health clinic, data envelopment analysis.

## 1.0 Introduction

A primary health care service provided at health clinic is the basic of country health system, and is a first contact between society and health care. It is a whole-of-society approach to health and well-being centred on the needs and preferences of individuals, families and communities (WHO & UNICEF, 2018). The primary health care is a trust of services includes health promotion, management of illness from prevention to treatment, rehabilitation and palliative care, and injury prevention and personal care - as close as feasible to people's everyday environment. It is the backbone of an effective health system (World Health Organization, 2018). In Malaysia, primary health care is delivering through services at health clinic level such as; outpatient services, maternal health services and child health services. It is important that scarce available resources for health services used efficiently to ensure health care need of population were met.

In Malaysia, primary care services started with maternal health services in the city then were later expanded to the rural area (MOH, 2017a). At present, maternal health services delivering are through various Ministry of Health facilities, namely; health clinics, maternal and child health clinics and community clinics which are scattered across the country. In urban area, private clinics also played roles providing maternal health services. Government health clinics in Malaysia were categorized into different types of health clinics according to the workload measured by the daily patient attendance to the health clinics.

There are total of about 1060 government health clinics in Malaysia (MOH, 2017). These health clinics has different types based on level of services, population coverage, manpower staffing and physical facilities, as shown in Table 1.

**Table 1:** Characteristics of Government Health Clinic in Malaysia

No.	Health Clinic	Catchment Population	Building Capacity (m <sup>2</sup> )	Patient Attendance Daily	Services											
					MCH	OPD	FMS	EMS	DS	CE&P	Reh	Cl. Lab	Phrm. &Disp	Img	ABC	Obs
1.	Type 1	>50,000	4000	>800	√	√	√	√	√	√	√	√	√	√	na	na
2.	Type 2	>50,000	4000	500 - 800	√	√	√	√	√	√	√	√	√	√	na	na
3.	Type 3	>30,000 to 50,000	3200	300 - 500	√	√	√	√	√	√	√	√	√	√	na	na
4.	Type 4	>20,000 to 30,000	2500	150 - 300	√	√	√	√	√	√	na	√	√	√	√	√
5.	Type 5	>10,000 to 20,000	1600	100 - 150	√	√	na	√	√	√	na	√	√	na	√	√
6.	Type 6	>5,000 to 10,000	700-800	50 - 100	√	√	na	√	√	√	na	√	√	na	√	√
7.	Type 7	≤5,000	400-500	30 - 50	√	√	na	√	√	√	na	√	√	na	√	√

Source: MOH, 2017a

Legends: MCH: Maternal and Child Health Services; OPD: Outpatient Services; FMS: Family Medicine Specialist Services; EMS: Emergency Services; DS: Dental Services; CE&P: Community Education & Promotion; Reh: Rehabilitation Services; Cl. Lab: Clinical Laboratory; Phrm & Disp.: Pharmacy and Dispensing Services; Img: Diagnostic Imaging Services; ABC: Alternative Birthing Centre; Obs: Patient Observation Beds

Maternal and child health services deliver at health clinics via several activities. The main activities for maternal health services includes; antenatal service, post-natal service, home visit, nutrition, family planning, counselling and others services. As for child health services, the activities include; immunisation, child development, home visit, nutrition and many others. The maternal and child health service are supported by varies others activities such as laboratory service, diagnostic and imaging, pharmacy and dispensing, alternative birthing centre and other services as indicated in Table 1. These services were provided by various trained personnel ranging from family medicine specialists and medical officers to public health nurses and community nurses as shown in Table 2 below.

**Table 2:** Key Manpower's, Financial Allocation and Utilization of Health Clinic

Years	2013	2014	2015	2016	2017	2018
<b>Key Manpower's:</b>						
Doctors	28,949	33,275	33,545	36,403	40,230	na
Ass. Medical Officer	10,641	11,305	12,198	12,812	13,904	na
Nurses	56,503	59,364	64,016	65,227	65,709	na
Community Nurses	23,971	25,128	24,926	24,510	23,495	na
<b>Financial Allocation (RM):</b>						
Operating	na	20,498,060,000	21,714,210,000	21,430,802,000	23,462,797,400	24,736,883,700
Development	na	1,662,320,300	1,597,702,500	1,600,264,400	1,338,188,800	1,845,055,100
<b>Total</b>	<b>na</b>	<b>22,160,380,300</b>	<b>23,311,912,500</b>	<b>23,031,066,400</b>	<b>24,800,986,200</b>	<b>26,581,938,800</b>
<b>Utilization:</b>						
Outpatient	33,379,603	35,444,379	38,311,233	40,154,008	42,882,285	na
Antenatal	5,794,544	6,117,418	5,999,528	6,003,606	6,196,751	na
Postnatal	556,852	564,726	552,260	531,019	520,704	na
Child Health	7,715,883	8,149,862	8,162,977	8,783,819	9,488,065	na
<b>Total</b>	<b>47,446,882</b>	<b>50,276,403</b>	<b>53,021,998</b>	<b>55,472,452</b>	<b>59,087,805</b>	<b>na</b>

Sources: MOH2014; MPH 2015; MOH2016a; MOH 2017b; MOH 2018

As shown in Table 2, the key personnel such as doctors (including family medicine specialist), assistant medical officer, nurses and community nurses also had shown increasing in numbers from 2013 to 2017. The numbers of doctors had been increased 39%, assistant medical officer 31% and nurses 16% in 2013 to 2017. Only community nurses had shown decreasing trend in 2017; these may be due upgrading exercise of facilities in rural area become health clinic and promotion of community nurse to staff nurses.

Each year almost 10% of national budget were allocated to Ministry of Health. Table 2 showed that there were slight increments of budget allocated to Ministry of Health from 2014 to 2018.

In term of utilization, over the years, there have been increasing numbers of patient attendance to the government's public health facilities for maternal health services. This finding reflects the uptake of the services by the community. During the past five years, antenatal patient attendance showed an increased in patient attendance. Overall, total patient attendance increased by 6.94% from a total of 5,794,544 in year 2013 to a total of 6,196,751 in 2017. Meanwhile, about 10.00% of national budget allocated to the MOH Malaysia for the past five years for operation and development purposes (MOH 2014, MOH 2015, MOH 2016, MOH 2017b and MOH 2018).

### *1.1 Technical efficiency of maternal health services*

In health sector, efficiency is to ensure available resources are utilized in a way to warrant population is a healthy as possible. The process of attainment value for money or acting with minimum expense, waste or effort is understood as efficiency. In production function process, firstly transforming input into output; secondly, costs of resources used are taken into consideration; and thirdly, those are compare with the value of output produced (Mills & Gilson, 1988).

Efficiency as a concept defines as a process of allocating resources or inputs to yield the maximum possible output or about doing thing in optimal way (Martinez-Giralt, 2010). It is ratio of total output to input. The basic equation of efficiency can be illustrated below:

$$\text{Efficiency} = \frac{\text{Weighted Sum of Output}}{\text{Weighted Sum of Input}}$$

There are two major types of efficiency, namely: allocative efficiency and technical efficiency. Allocative efficiency refers to allocations of resources yielding the maximum possible output. Allocative efficiency occurs when goods and services are distributed according to consumer preferences. An economy could be productively efficient but produce goods people don't need this would be allocative inefficient.

Technical efficiency is the effectiveness with which a given set of inputs is used to produce an output. Technical efficiency means the ability of a production unit or decision making unit

(DMU) achieve maximum output with the given level of input or minimum amount of resources used with the given level of output (Akazili et al., 2008a; Obure et al., 2016). An organization is technically efficient if it is producing the maximum output from the minimum quantity of inputs, such as labor, capital and technology. The technical efficiency scores can be decomposed into pure technical efficiency and scale efficiency to determine the main source of the technical efficiency (Abel, S & Bara, A. 2017). Pure technical efficiency refers to producing a maximum amount of output from a given amount of input or alternatively, producing a given output with minimum input quality (Farrell, 1957); and on the other hand scale efficiency refers to the relationship between the level of output and the average cost hence it relates to the size of operation in the organisation. (Achoki et al., 2017).

### 1.2 Measuring Technical Efficiency

There are two basic methods to measuring technical efficiency; parametric approaches and non-parametric approaches (Box 1).

#### Box 1: Measuring Technical Efficiency

Parametric	Non-Parametric
<i>Stochastic frontier approach (SFA)</i> (Greene, 1993; Lovell, 1993)	<i>Data Envelopment Analysis (DEA)</i>
<i>Thick Frontier Approach (TFA)</i> (Berger and Humphrey, 1991, 1992; Berger et al, 1993)	<i>Free Disposal Hull (FDH) Methods</i> (Arshinova T., 2007)
<i>Distribution Free Approach (DFA)</i> (Schmidt and Sickles, 1984; Berger, 1993)	

Both approaches of parametric and non-parametric have their own merits and demerits to measure organisational efficiency.

In this study DEA method were used to determine maternal health services efficiency. Basically, DEA is a Linear Programming Problem that provides a means of calculating apparent efficiency levels within a group of organizations. The efficiency of an organisation is calculated relative to the group's observed best practice.

Typically using linear programming, DEA measures the efficiency of an organisation within a group relative to observed best practice within that group.

## 2.0 Study objective

This study aimed to assess technical efficiency of maternal health services and its determinants in primary care setting of health clinics in Negeri Sembilan using data envelopment analysis (DEA).

### **3.0 Methodology**

#### **3.1 Study site**

Negeri Sembilan is one of the states in Malaysia and has seven districts. It is located on the Peninsula's southwest coast. The estimated population was about 1.11 million in 2017 with an annual population growth rate of 1.4% (MOH, 2019). Negeri Sembilan was chosen because it is among states in Malaysia shows high maternal mortality rate. Negeri Sembilan also had shown a steep rise in MMR from 40.9 in 2008 to 45.3 in 2011 respectively (MOH, 2014).

#### **3.2 Study design**

This is an evaluation research employing cross-sectional study design to determine technical efficiency of maternal health services of health clinics in Negeri Sembilan. The study consist of two-stage; the stage-one involve determination os efficiency score, and stage-two involve environmental variable analysis.

#### **3.3 Sample size**

Out of 47 health clinics in Negeri Sembilan, 16 DMUs or maternal health clinics were sampled using stratified random samplings to include six types of health clinics available (Note: In Negeri Sembilan there is no Health Clinic Type 7). The study samples were obtained from each type of health clinics in Negeri Sembilan for year 2016 and 2017. Based on literature, sample of 16 DMUs were sufficient for DEA analysis (Azreena et al, 2018).

#### **3.3 Data collection**

This study using primary data obtained from district health office administrative records, health clinics records and patients medical records. The inputs data such as number of doctors, number of nurses, expenditures were collected from district health office. Output data; the total number of patient attendance at maternal health services were obtained from health clinics records.

Environmental variables data such as location of health clinic, distance of health clinic to the nearest health facility and comorbidity of patients were obtained from patients medical records. The years of service of nurses was obtained from district health office.

#### **3.4 Data Analysis**

This study employed a two-stage DEA method. In stage one DEA, data collected were entered in excel spreadsheet. Using Output-orientation and VRS approach data were computed

to OTE, PTE and SE score using Data Envelopment Analysis Programme version 2.1 (DEAP 2.1). Output-orientation approach was preferred as it is unethical to suggest health clinics to reduce services and in addition, number of doctors and nurses were mainly determined by higher level. The VRS approach was chosen because all health clinics were not likely to be operating at optimal scale. An efficiency score of 1.00 or 100.00% will indicate that the DMUs are efficient. An efficiency score of less than 1.00 or 100.00% shows that the DMUs are inefficient. Data envelopment analysis is a benchmarking method that is able to demonstrate the best-practice units and the DMUs becomes a benchmark for the inefficient ones (Adler et al., 2002). In stage two DEA, environmental variables were expected to influence the technical efficiency of health clinics. The data for environmental variables were analyzed using Tobit regression with STATA version 13.0.

## 4.0 Results

In this results section, the efficiency score in term of OTE, PTE and SE were presented. All sixteenth health clinics were identified by generic name (MAT1.....to 16) which was not real name of the health clinics.

### 4.1 Technical efficiency of maternal health services

Table 3 shows that the DEA efficiency score for maternal health services of health clinics in Negeri Sembilan for years 2016 and 2017.

**Table 3:** DEA efficiency scores for 16 maternal health services in Negeri Sembilan

DMUs (Health clinics)	2016			Returns to scale	DMUs (Health clinics)	2017			Returns to scale
	Efficiency scores					Efficiency scores			
	OTE	PTE	SE			OTE	PTE	SE	
MAT1	0.601	0.613	0.981	drs	MAT1	0.617	0.780	0.790	irs
MAT2	1.000	1.000	1.000	-	MAT2	0.559	0.871	0.642	irs
MAT3	0.212	0.556	0.382	irs	MAT3	0.207	1.000	0.207	irs
MAT4	0.187	0.226	0.83	drs	MAT4	0.182	0.200	0.912	drs
MAT5	0.137	0.153	0.894	irs	MAT5	0.199	0.274	0.728	irs
MAT6	0.190	0.19	1.000	-	MAT6	0.079	0.100	0.790	irs
MAT7	0.193	1.00	0.193	irs	MAT7	0.209	1.000	0.209	irs
MAT8	0.221	0.287	0.770	drs	MAT8	0.250	0.271	0.920	drs
MAT9	0.140	0.197	0.713	irs	MAT9	0.163	1.000	0.163	irs
MAT10	0.937	1.000	0.937	irs	MAT10	0.862	0.876	0.984	irs
MAT11	1.000	1.000	1.000	-	MAT11	1.000	1.000	1.000	-
MAT12	0.855	0.856	0.999	drs	MAT12	1.000	1.000	1.000	-
MAT13	0.887	0.888	0.999	drs	MAT13	0.582	0.605	0.961	drs
MAT14	0.480	0.512	0.938	drs	MAT14	0.392	0.392	1.000	-
MAT15	0.133	1.000	0.133	irs	MAT15	0.083	0.391	0.212	irs
MAT16	0.196	0.197	0.993	drs	MAT16	0.117	1.000	0.117	irs
<b>Mean</b>	0.461	0.605	0.798		<b>Mean</b>	0.406	0.673	0.665	

<b>SD</b>	0.355	0.355	0.296	<b>SD</b>	0.323	0.343	0.352
<b>Min</b>	0.133	0.153	0.133	<b>Min</b>	0.079	0.100	0.117
<b>Max</b>	1.000	1.000	1.000	<b>Max</b>	1.000	1.000	1.000

Note: OTE= overall technical efficiency from CRS DEA; PTE= pure technical efficiency from VRS DEA; SE=scale efficiency=OTE/PTE; irs=increase return to scale; drs=decrease return to scale

MAT: *abbreviation for health clinic*

As for maternal health services in 2016, two (12.50%) maternal health clinics were constant return to scale technically efficient, five (31.25%) were variable return to scale technical efficient and three (18.75%) were scale efficient. In 2017, the number of constant return to scale technically efficient maternal health clinics were same (12.50%), but additional one maternal health clinic obtained variable return to scale technical efficient (37.50%) and scale efficient health clinics were same (18.75%).

#### 4.2 Improvement of efficiency score of maternal health services

Table 4 demonstrates the output increment and or input reductions that would enable the variable returns to scale technical inefficient maternal health services to be efficient in 2017.

**Table 4:** Efficiency score, actual and target inputs and output quantities for inefficient maternal health services according to VRS approach 2017

DMUs	Score	Output/Input	Actual quantities	Target Quantities	Difference	%
MAT1	0.780	Patient attendance	4160.00	5331.64	1171.64	28.16
		Number of doctors	1.00	1.00	0.00	0.00
		Number of nurses	7.00	5.52	-1.48	-21.13
		Expenditure	337248.37	337248.38	0.01	0.00
MAT2	0.871	Patient attendance	3520.00	4041.30	521.30	14.81
		Number of doctors	1.00	1.00	0.00	0.00
		Number of nurses	6.00	4.94	-1.06	-17.65
		Expenditure	295134.79	295134.79	-0.01	0.00
MAT4	0.200	Patient attendance	3520.00	17618.00	14098.00	400.51
		Number of doctors	3.30	3.16	-0.14	-4.24
		Number of nurses	15.00	10.00	-5.00	-33.33
		Expenditure	840569.34	722699.91	-117869.44	-14.02
MAT5	0.274	Patient attendance	1836.00	6701.75	4865.75	265.02
		Number of doctors	2.31	1.57	-0.74	-32.08
		Number of nurses	6.00	5.86	-0.14	-2.28
		Expenditure	377871.64	377871.64	0.00	0.00
MAT6	0.100	Patient attendance	639.00	6393.85	5754.85	900.60
		Number of doctors	1.32	1.32	0.00	0.00
		Number of nurses	6.00	5.84	-0.16	-2.60
		Expenditure	369613.40	369613.40	0.00	0.00
MAT8	0.271	Patient attendance	4781.00	17618.00	12837.00	268.50
		Number of doctors	7.26	3.16	-4.10	-56.47
		Number of nurses	11.83	10.00	-1.83	-15.47
		Expenditure	785446.01	722699.91	-62746.10	-7.99



MAT10	0.876	Patient attendance	10451.00	11931.03	1480.03	14.16
		Number of doctors	2.00	2.00	0.00	0.00
		Number of nurses	8.00	8.00	0.00	0.00
		Expenditure	565623.46	545620.22	-20003.24	-3.54
MAT13	0.605	Patient attendance	5964.00	9852.12	3888.12	65.19
		Number of doctors	1.50	1.50	0.00	0.00
		Number of nurses	8.00	7.31	-0.69	-8.63
		Expenditure	517953.05	481187.76	-36765.29	-7.10
MAT14	0.392	Patient attendance	2942.00	7513.00	4571.00	155.37
		Number of doctors	1.00	1.00	0.00	0.00
		Number of nurses	8.50	6.50	-2.00	-23.53
		Expenditure	417696.11	408443.14	-9252.97	-2.22
MAT15	0.391	Patient attendance	527.00	1348.04	821.04	155.80
		Number of doctors	1.65	1.03	-0.62	-37.39
		Number of nurses	3.63	3.63	0.00	0.00
		Expenditure	260914.78	211377.73	-49537.06	-18.99

Using DEA method, it was able to calculate the target output and inputs for the 10 technical inefficient maternal health clinics. In 2017, all 10 (100.00%) maternal health clinics must increase patient attendance, four (40.00%) maternal health clinics have to reduce the number of doctors, eight (80.00%) ought to reduce the number of nurses and six (60.00%) health clinics must reduce the expenditure in order for maternal health services to be efficient.

#### 4.3 Technical Efficiency of Maternal Health Services According to The Types of Health Clinic

Table 5 presents the mean technical efficiency of maternal health services according to the type of health clinics.

**Table 5:** Mean pure technical efficiency of maternal health services according to the types of health clinic

Type of Health Clinic	Technical Efficiency	
	2016	2017
1	0.287	0.271
2	1.000	0.876
3	0.613	0.600
4	0.604	0.610
5	0.657	0.727
6	0.197	1.000

In 2016, type 2 maternal health clinic was technical efficient with the score of 100.00% and type 6 has the lowest technical efficiency score of 19.70%. In 2017, type 6 became technical efficient with the score of 100.00% while type 1 maternal health clinic has the lowest technical efficiency score of 27.10%.

#### 4.4 Determinants of maternal health services

Table 6 shows the association between environmental variables and technical efficiency of maternal health services.

**Table 6:** Determinants of Maternal Health Services Affecting Technical Efficiency

Variable	Coefficient	Std Error	t-Statistic	Prob.
Location (Urban/Rural)	0.114	0.171	0.67	0.509
Distance nearest health facility (in Km)	0.003	0.008	0.41	0.687
Years of service of nurses ( $\geq 6$ years)	0.021	0.018	1.16	0.257
Comorbidity of patient	-10.867	4.830	-2.25	0.032
Constant	1.590	0.512	3.10	0.004
F (5,29)				3.56
Prob > F				0.018
Pseudo $R^2$				0.280

Note: (\*) =  $p < 0.01$ , (\*\*) =  $p < 0.05$ , (\*\*\*) =  $p < 0.1$

As for maternal health services, comorbidity of patient was shown to significantly influence technical efficiency of maternal health clinics ( $p = 0.03$ ). With an increase of 1 co-morbidity of patient is associated with a 1086.70% decrease in efficiency at 5.00% significance.

## 5.0 Discussion

### 5.1 Technical efficiency of maternal health services

As for maternal health clinics, in 2016, mean OTE score was 46.10% while mean PTE score was 60.5%. Overall technical inefficiency (53.90%) of maternal health services in Negeri Sembilan was attributed by health clinics managers whom were not selecting suitable input combinations and not following proper management practices (39.50%). The other reason for underperformance was due to inappropriate scale size of maternal health clinic (20.20%). Three maternal health clinics namely MAT7, MAT10 and MAT15 constant return to scale technical inefficiency was completely attributed to scale inefficiencies. However, in 2017, overall technical inefficiency (59.40%) of maternal health services in Negeri Sembilan was attributed by both health clinics managers who has poor input usage (32.70%) and failure to operate at the utmost productive scale size (33.50%). Four maternal health clinics namely MAT3, MAT7, MAT9 and MAT16 constant return to scale technical inefficiency was wholly attributed to scale inefficiencies. Ten out of 13 inefficient maternal health clinics showed that maternal health clinic patient attendance would increase in a greater proportion for this study

with an increase of number of doctors, number of nurses and expenditure. The findings suggest that low performance was due mainly to poor input usage instead of failure to operate at the most productive scale of operations. It could be due to the healthcare model in Malaysia's shift from a three-tier system to a two-tier system resulting in increased number of community and health clinics which ultimately increased the spread and outreach of the Malaysian healthcare system (Lee, 2015).

A study in Colombia studied on antenatal care obtained average efficiency score of 92.00% with 57.10% of the health clinics were technical efficient (Ruiz-Rodrigues et al., 2016). The findings were higher as compared to this current study and it could be due to the inclusion of postnatal care in this study. A study in China highlighted that maternal health services were often underutilized (Zhang et al., 2016). When we observed 2016 and 2017, there has been increase number of scale inefficient health clinic which proposed that increase in output was not proportionate to the increased number of inputs and this finding was similar to a study conducted in Guatemala (Hernandez & Sebastian, 2014). Our findings agree relatively well with a study conducted in Zambia where the findings suggest that low performance was due mainly to poor input usage instead of failure to operate at the most productive scale of operations (Achoki et al., 2017).

### ***5.2 Technical efficiency of maternal health services according to the type of clinic***

Maternal health clinic in health clinic type 2 in Negeri Sembilan was the most technical efficient in 2016 with the mean pure technical efficiency score of 100.00%. On the other hand, maternal health clinic in health clinic type 6 was the most technical efficient in 2017 with the mean score of 100.00%. A huge jump of mean efficiency score from the year before. It was noted that maternal health clinic in health clinic type 6 functioned with marked reduced in the number of nurses and expenditure but also has reduced number of patient attendance in 2017. Maternal health clinic type 2 located in the urban location and type 6 located at the rural location. This study indicates that in 2016, urban health clinics managers able to utilize resources efficiently but in 2017, type 6 health clinic managers performed better.

In this study, noted slightly lower mean PTE score as compared to a study on technical efficiency of rural health post noted mean PTE score was 57.00% (SD 32.00) (Sebastian & Lemma, 2010). In the same study, low mean PTE was the result of poor performance by 75.00% of health posts which were conducting less activities than the optimal levels (Sebastian & Lemma, 2010). Despite having run by two health staffs of high school graduate and one year of training, they are supported by a total of 13.00 community health workers and traditional birth attendants. Most of the health posts were scale efficient. Therefore, the study suggested health staff to increase preventive and curative activities including family health service with the current resources. However, with two-tier health system settings in Malaysia, one health clinic previously cater for 50,000.00 populations is now catering for 15,000.00 to

20,000.00 population and presence of community clinics are for 3,000.00 to 4,000.00 populations. These provide maternal health services not only focus at health clinic but also in community clinics. Therefore, this does not reflect the true managerial efficiency.

A study in rural maternal and child health posts had similar results as mean OTE was 42.70% (SD 43.60), mean PTE was 68.20% (SD 27.20) and mean SE was 52.80% (SD 50.60) (Kirigia et al., 2011). In the same study, regardless of the size of the health clinics, either bigger or smaller, the results were similar. Moreover, inefficient health posts were required to increase outputs by increasing patient visits to the health posts to be efficient. This can be done by boosting demand for underutilized services by removing barriers to access health services, create leveraging behaviour-change community health programmes and use health promotion. Inefficient maternal health clinic in Negeri Sembilan should work towards increasing total patient attendance by 12.00% to 73.00% in order to be efficient. A study in Sarawak, Malaysia showed that significantly more pregnant women from rural had early antenatal care booking ( $p = 0.00$ ) and urban dwellers were less contraceptive users than the rural dwellers. (Win et al., 2017). In the same study, lower coverage of neonatal tetanus in rural areas as compared to urban areas. Using this information, health clinic managers were able to know the target population and plan resources carefully in order to get the urban mothers to come to maternal health clinics for early antenatal booking encourage postnatal mothers for contraception and lastly encourage neonatal tetanus injection in rural areas. Health clinic managers ought to provide more health information and health education to the target population.

### ***5.3 Determinants of Maternal Health Services***

There was no significant association between location of maternal health clinic and pure technical efficiency of maternal health clinics in Negeri Sembilan. A study on maternal and child health services measured at district level revealed that urban districts have a dense population environment and have better access to health service in terms of finance and physical (Achoki et al., 2017). In Malaysia, maternal health services have been long established and can be seen with the paradigm shift in healthcare delivery from curative to prevention, urban to rural and three-tier system to two-tier system (MOH, 2017a). This could explain location of health clinic regardless in urban or rural, it is not significantly associated with technical efficiency.

There was no significant association between distance of health clinic to the nearest health facility and pure technical efficiency of maternal health clinic in Negeri Sembilan. A study revealed that the more the distance of health clinic to the reference hospital, the more efficient if the health clinic (Ferreira et al., 2013). Maternal health clinic has been long established and presence of good follow up and resulting in presence of continuation of care provided for the patients which might be the reason why distance to the nearest health facility does not matter.

There was no significant association between years of service of nurses and pure technical efficiency of maternal health clinic in Negeri Sembilan. Increase years of service should increase efficiency of maternal health services as gaining of experience and familiarizing with the work. A study used number of years since the hospital started service delivery as an environmental variable to measure technical efficiency of maternal and reproductive health service in public hospital and revealed significant positive association with efficiency of the hospital (Yitbarek et al., 2019). An increase in years of service increased 2.00% of efficiency ( $p = 0.02$ ).

There was significant association between comorbidity of patient and pure technical efficiency of maternal health clinic in Negeri Sembilan. This study revealed that with an increase of 1 co-morbidity of patient is associated with a 1086.70% decrease in technical efficiency maternal health clinics ( $p = 0.03$ ). Health clinics function as the gate keeping. Malaysia has risk-stratification strategy for antenatal care to improve maternal or neonatal outcome and ultimately to reduce maternal mortality rate (MOH, 2017a). If a patient has more comorbidity are higher risk, patient would be seen by a Family Medicine Specialist in the maternal health clinic or patient would be referred to the obstetrics and gynecology specialist at hospital (Yeoh et al., 2016). Hence, less patient would be seen in the maternal health clinic and this could lead to the reduced efficiency. This also reflects that health clinics managers were managerial inefficient as they have poor input utilization.

## 6.0 Conclusion

The findings from this study found that technical efficient maternal health services in Negeri Sembilan were five (31.25%) and six (37.50%) in 2016 and 2017 respectively. In 2016, technical inefficiency mostly due to managerial inefficiency while in 2017 was attributed by both managerial inefficiency and failure to operate at the most productive scale size. Target inputs and output were identified from this study. This enables the health clinic managers to know the direction for inefficient health clinics to improve. Health clinic managers should conduct a comprehensive planning in terms of resource allocation and increasing work force productivity in achieving efficiency. Technical efficiency of DMUs varies according to the type of health clinic hereby; type 2 and type 6 health clinics were more efficient as compared to others. Patients with more co-morbidity significantly decrease technical efficiency of maternal health services.

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## Declaration

Author(s) declare that there is no conflict of interest regarding publication of this article.

## Author's contribution

Author 1 : information gathering, preparation and editing of manuscript  
Author 2 : final review of manuscript and final editing  
Author 3 : review of manuscript  
Author 4 : review of manuscript  
Author 5 : review of manuscript

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