COMPARATIVE ANALYSIS OF PUBLIC AND PRIVATE HEALTHCARE PROVIDERS' TECHNICAL EFFICIENCY IN MUBI METROPOLIS

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ABSTRACT

There has been a strong debate for decades over which is the most efficient healthcare services provider between private and public healthcare providers. This study therefore, dwelled on the c*omparative analysis of technical efficiency between Private and Public Healthcare providers in Mubi Metropolis*. Mubi metropolis comprises of two Local Government Headquarters (Mubi North & Mubi South). *Data used were both Primary and secondary and the methodology of the data analysis for this study was Data Envelopment Analysis (DEA). The inputs used in the study were number of doctors, nurses, CHEW, JCHEW as proxies for health technicians and number of beds in the health care centers while the outputs were in-patients, out-patients and child immunization. The study revealed that, most of the public health care centers were more technically efficient than the private's ones with the mean technical efficiency scores 0.9198 and 0.7696 respectively. Similarly, the study also revealed that the mean scale efficiency for public health care centers is greater than the private health care centers in Mubi metropolis with the score of 0.8322 and 0.7164 respectively. The study therefore, recommends that both public and private hospitals should adopt modern administrative techniques and adequate supervision for proper services that will lead to better technical and scale efficiency. Moreover, other methodologies should be considered for this comparative analysis by future researchers.*

Keywords: *Public, Private, Efficiency, Healthcare, CHEW[1], JCHEW[2], Data Envelopment Analysis (DEA)*

Introduction

Healthcare sectors play vital role in the providing of healthcare services as a tool for effective and efficient health care system performance. Appropriate healthcare spending is required to accelerate the improvement in quality and quantity of different healthcare services, access to healthcare services, health outputs and health outcomes (Dauda, 2012). One of the most important macroeconomics goals of any country is to improve the well-being of it citizens. The standard of living of an individual is widely accepted as a measure of a given population. To increase National Per Capita GDP, countries will adopt policies that aim at improving investment in human capital development and technological driven production process (Obafemi *et'al*, 2020).

[1] Community health workers,
[2] Junior community health workers

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Health is key components of human capital that determine economic growth. A healthy person is one with comprehensive mental, physical, and social well-being and not merely when there is absence of illness (WHO, 2001). Research evidence shows that health has a strong positive impact on economic growth which in turns improves health. Good health significantly boosts individual well-being, labour participation, productivity and contributes immensely to economic performance (Hsiao & Healter, 2007; Bloom &Canning, 2000). However, sound health care is the essential condition for having a social and economical productive life (Oyewole, 2018). Access to health care services is a multidimensional process involve the quality of health care, geographical accessibility of different types of health care, financial accessibility and acceptability of services (peter *et'al.*, 2018)

Nigeria is ranked 142 out of 195 countries according to Lancent reports ranking of health system performance using health care access and quality as a criterion, it was ranked low going by the World Bank Universal Health Coverage Services Index (Amendari & Ejidike, 2021). Access to quality, health care services remained inadequate in Nigeria. Only 39% of the population was estimated to have access to essential healthcare services due to numerous factors such as financial and geographical limitations (WHO, 2022). Though 52% of the Nigerian population dwells in a rural area, yet, relative to other countries statistics shows Nigeria, has an many public health care amenity, favourable health worker density, and realistic geographical access to healthcare service areas (WHO, 2017).

Thus far, the country's health care scheme remains feeble as a result of disjointed supply chains, limited access financial support, weak health worker commitment, malingering and limited inputs (such as drugs, equipment, and vaccines etc.) at the amenities, (Daniel *et'al.*, 2016*)*. Not up to 50% of public health care facilities in Nigeria have basic medical supplies where many lack elementary facilities like power, and alternative ambulance services (WHO, 2017). Moreover, private sector bridged a momentous gap in medical service delivery, supplying over 50% of healthcare services, with patent and proprietary medicine vendors (PPMVs) mostly serving as the first call center for medical care for most of the people (Abubakar *et'al.*, 2022). Nigeria with more than 200 million people suffer from high rates of avertible mortality (NPC, 2020). Statistics indicates that neonatal mortality per 1,000 live births, under-five mortality per 1,000 live births, and maternal mortality per 100,000 live births are all on the higher unfavorable rate. only (Oyeyemi *et'al.*, 2020).

Over the years, there has been a strong debate between public and private in the provision of healthcare services. This is owing to patients do access health care services from both public and private. But both side claims to be biased in terms of health care services provides as more efficient than the other. The users of private health sectors advocate more efficient and effective as a result of market competition, which will be overwhelmed government wastefulness and exploitation. According to Ibikunle (2019) In contrast, private health care sector highlighted inadequate pay for private services, inability to provide public health goods with preventive services, lack of harmonized planning, are responsible for poor health outcomes. This has made the proponents of the public sectors have confidence that public healthcare provision is of most benefit to poor people and is the only way to achieve universal and equitable access to health, but the problem as to whether private is more efficient than public still persist. This study therefore, went ahead to look at which one is more efficient in terms of geographical location and their operational services.

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The broad objective of the study is to analyze the Comparative Analysis of Technical Efficiency between Public and Private Health Care Centers in Mubi Metropolis. While the specific objectives are to: examine the technical efficiency of public and private healthcare centers in the study area and Based on this study hypothesis has been formulated as: H_0: Most of the private and public health care centers in Mubi metropolis are technically inefficient. Following this introduction, section two literature reviews and theoretical framework, section three methodology, section four results and discussion while section five summary, conclusion and recommendations.

Literature Review

According to World Health Report (2010), Technical efficiency refers to the extent that resources are being wasted. It measures the degree of producing the maximum amount of outputs from a given amount of inputs or conversely, using minimum amount of input to produce a given output. Examples of inefficiency are excessive hospitals length of stay, over processing, over staffing, use of branded over generic drugs and wastage stock efficiency is concerned with optimal production, consumption and distribution of scarce resource. In the same vein, Wu, Wang and Zhang (2015) Efficiency is a measure of the amount of output in relation to a given level of input and technical efficiency (TE) is often used to represent the efficiency of health care services.

According to Akanni (2015) health efficiency is concerned with the relationship between resources inputs (labour, capital, material or equipment), e.g number of patients treated, lives saved. Existence of inefficiency is indicated by possible reallocation of resource in a number that results in increase in health outcomes produced. Technical efficiency of hospitals or health facility refers to the physical relation between health resources capital, labour and materials and health outcomes.

Theoretical Review

Economic competition theory, states that zero-profit condition is happens once an industry or business has an tremendously low (near-zero) cost of entry to or exit from the industry. In this context, some new firms tend to register in the industry forecasting they will record normal profit in excess of the cost of acquiring investible funds. Multiple new firms will join till the normal profit dropped to zero through competition. Equally, when firms record losses, plentiful firms will leave the industry till normal profit per firm has increased above zero.

This describes a scenario of perfect competition. The situation with zero economic profit is referred to as the industry's long run.

According to the theory of contestable markets, if few enough firms are in the industry so that one would expect positive economic profits, the prospect of other firms entering the market may cause firms in the industry to set prices as if those other firms were already in the market; thus actual entry by those firms is not necessary for the market to appear perfectly competitive.

The relevant variables are **p, w, x, and f(x). p** is the price of the output, **w** is the price of the input, **f(x)** is the amount of output, and **x** is the amount of input. Thus, the profit-function can be written as the following:

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(p, w) = maximize **((p • f(x)) - (w • x))**

Let us consider a case where profits are strictly positive and as we increase inputs by a factor of a constant, **y,** we get increasing profits. **y** is greater than **1**. This can be modeled using our profit function from before below where **k** is our initial profit:

Initially: **(p • f(x)) - (w • x) = k and k>0**

When we increase inputs by a factor of y: **(p • f(y • x)) - (w • (y • x)) >= (y • k) > k** where we have assumed constant or increasing returns to scale.

We can see that when we increase inputs by a factor of y, we obtain increased profits. Thus, as we consistently increase the firm's inputs, the firm's profits also consistently go up and there is no limit at which the firm's profits start decreasing.

In a perfectly competitive market, there are minimal to no barriers to entry. Thus, prospective firms, seeing that there is a profit to be made, will start entering the market, which would then decrease the current profit per firm because there is only a limit to demand. Consequently, this keeps happening until there is zero profit per firm in the market. When this happens, firms will not have incentive to enter the market making zero profit the equilibrium point in this market.

This can also be illustrated in the opposite way. Let us consider a case where there are too many firms in the market, causing a negative profit. A negative profit would mean that firms would start to leave the market. As firms leave, there is more profit per firm. This gradually increases to an amount of 0 profits per firm, where firms do not have incentive to leave the market or join the market.

A Kaldor–Hicks improvement, named for Nicholas Kaldor and John Hicks, is an economic re-allocation of resources among people that captures some of the intuitive appeal of a Pareto improvement, but has less stringent criteria and is hence applicable to more circumstances. A re-allocation is a Kaldor–Hicks improvement if those that are made better off could hypothetically compensate those that are made worse off and lead to a Pareto-improving outcome. The compensation does not actually have to occur (there is no presumption in favor of status-quo) and thus, a Kaldor–Hicks improvement can in fact leave some people worse off.

A situation is said to be Kaldor–Hicks efficient, or equivalently is said to satisfy the Kaldor–Hicks criterion, if no potential Kaldor–Hicks improvement from that situation exists. If an outcome is the highest it could possibly be, it is called a Hicks-optimal outcome. A Hicks optimal outcome is always Pareto efficient.

A reallocation is said to be a Pareto improvement if at least one person is made better off and nobody is made worse off. However, in practice, it is almost impossible to take any social action, such as a change in economic policy, without making at least one person worse off. Even voluntary exchanges may not be Pareto improving if they make third parties worse off.

Using the criterion for Kaldor–Hicks improvement, an outcome is an improvement if those that are made better off could in principle compensate those that are made worse off, so that a Pareto improving outcome could (though does not have to) be achieved. For example, a voluntary exchange that creates pollution would be a Kaldor–Hicks improvement if the buyers and sellers are still willing to carry out the

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transaction even if they have to fully compensate the victims of the pollution. Kaldor–Hicks does not require compensation actually be paid, merely that the possibility for compensation exists, and thus need not leave each at least as well off. Under Kaldor–Hicks efficiency, an improvement can in fact leave some people worse off. Pareto-improvements require making every party involved better off (or at least none worse off).

Pareto efficiency or Pareto optimality

Pareto efficiency or Pareto optimality is a situation where no action or allocation is available that makes one individual better off without making another worse off. The concept is named after Vilfredo Pareto (1848–1923), Italian civil engineer and economist, who used the concept in his studies of economic efficiency and income distribution. The following three concepts are closely related:

i. Given an initial situation, a Pareto improvement is a new situation where some agents will gain, and no agents will lose.
ii. A situation is called Pareto-dominated or Pareto-inefficient if there is some possible Pareto improvement that has not been made.
iii. A situation is called Pareto-optimal or Pareto-efficient if no change could lead to improved satisfaction for some agent without some other agent losing or, equivalently, if there is no scope for further Pareto improvement (in other words, the situation is not Pareto-dominated).

In addition to the context of efficiency in allocation, the concept of Pareto efficiency also arises in the context of efficiency in production and x-inefficiency: a set of outputs of goods is Pareto-efficient if there is no feasible re-allocation of productive inputs such that output of one product increases while the outputs of all other goods either increase or remain the same.

Pareto efficiency is measured along the production possibility frontier (PPF), which is a graphical representation of all the possible options of output for two products that can be produced using all factors of production.

Empirical Review

Hollingsworth & Parkin (1998) viewed efficiency analysis of production or services unit as the comparison between the input and output used in the process of producing a product or services. According to Zainal & Ismail (2010) efficiency is also relates to how best a firm utilizes the resources (inputs) to produce the desire products or services (outputs), which indicates the success of firm.

Oyewole (2018) carried out a study on the Utilization of Primary Health Care Services among Rural Dwellers in Oyo State. A simple random sampling technique was used to select 147 respondents. The study revealed that, about (65.3%) of the respondents were between the age of 35 and 54 years. 61.2% were male, a mean value of 1.13 was the greatest constraint faced by most of rural household with (53.3%). There was a significance relationship between age ($r = -0.337$, $P = 0.000$), years of formal education ($r = 0.566$, $P = 0.000$), household size ($r = 0.515$, $P = 0.000$), ailments ($r = 0.566$, $P = 0.000$) and constraint status encountered ($r = 0.575$, $P = 0.000$) towards utilization of primary health care services in the area. In the same vein, the study carried out by Ichoku (2014) on Modeling Technical Efficiency of Hospitals in South-Eastern Nigeria using Stochastic Frontier Analysis. The result revealed that, there is large variation in the efficiency

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score of sample healthcare facilities with the average efficiency score of 71%. And private hospitals show greater level of efficiency than the public hospitals.

Amedari and Ejidike (2021) Carried out a study on Improving Access to Quality and Efficiency of Healthcare Delivery in Nigeria, The study revealed in order cub the issue of corruption in the health sector, policy options such as revamping the primary health care and prioritizing the delivery of basic minimum package of health care are used to considered. This can be achieved through proper financially right choice in resources. Similarly, in the study carried out by Ibekunle (2019) on Efficiency and Productivity Pattern of Public and Private Hospitals in Oyo State Nigeria for the period of 2016 to 2017. The study revealed that, public hospitals were more efficient than private hospitals in terms of technical, allocative and cost efficiency with the mean score of (0.858, 0.822 and 0.707) and private hospitals (0.690, 0.616 and 0.425).

Akwara and Susan (2019) took a study on Determinants of Relative Technical Efficiency of Hospitals in Nigeria: A two-stage Approach. The study revealed that, the average level of technical efficiency was higher in the private hospitals (10.6%) than the public hospitals (8.7%) for the five period of the study. While on the basis of size, the level of inefficiency was higher for the medium size hospitals (10.6%) than that of small size hospitals (9.1%). In the same way, the study did by Arhin (2023) on Assessing Efficiency of Health System in Achieving the Universal Health Coverage Goal: Evidence of Sub-Saharan Africa. Bootstrapping Oriented Data Envelopment Analysis (DEA) was employed. The result revealed that, the universal health coverage (UHC) ranged from minimum of 52% to maximum of 81% with a mean coverage of 66%. The average bias corrected efficiency score was 0.81 (95% CL = 0.77 to 0.85) it also revealed that, education, governance quality, public health spending, external health funding and prepayment arrangements that pool fund for health had positive significant effect on the health system efficiency in improving UHC, while out-of-pocket payments had a negative significant impact.

Babalola and Modley (2020) conducted a study on Assessing the Efficiency of Health care Facilities in Sub-Saharan Africa: A systematic review. The study revealed that, a total of 40 studies were shortlisted for the review and the majority (90.0%) of the study employed Data Envelopment Analysis Techniques for their efficiency measurement. The outcome for the majority of the study showed that less than 40% of the studies facilities were efficient while the leading influencing factors reported by the studies were catchment population facility ownership and location.

Asbu (2022) conduct a study on Technical Efficiency of Health Production in Africa: A Stochastic Frontier Analysis was employed from 2000-2015.the study revealed that, the mean technical efficiency score were 79.3% in 2000, 81% in 2005, 85.6% in 2010 and 88.3% in 2015. Carbo Verde registered the highest technical efficiency score. While Eswatin and Siera-leon has the lowest there is significant degree of technical efficiency. In the same vein Muringa (2023) did study on Technical Efficiency of Health System in the WHO African Region. Data Envelopment Analysis was employed and the study showed that, health care system in Africa was 80% efficient means that every 5 dollars spend on health is lost to technical inefficiency. It also revealed that African countries become more efficient, improving by 13% between 2014 (67%) and 2019 (80%) efficient.

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Methodology

The data used in this study were Primary and Secondary data sourced through field survey, interview, questionnaire, and the Health Care providers' records.

DEA Model Specification

This study employs both the Charnes, Cooper & Rhodes (CCR) and Barker, Charnes & Cooper (BCC) input-oriented model for 14 Health Care Facilities (HCF) with each DMU having Y outputs and X inputs (where Y = 3 and X = 2). In order to achieve the objectives of this research, modified DEA model is stated. The outputs Y are three i.e. in-patients, outpatients and child immunization while the inputs X are two i.e. health technician (number of doctors, nurses, CHEW and JCHEW) and number of beds. The selection of Health Care Facilities inputs and outputs is done with conformity of the existing literature. According to Charnes, Cooper & Rhodes (1981) the modified model for DEA is as follows:

$$\text{Efficiency} = \max \sum_{r}^{p} UrYrjo + u$$

Subject to: $\sum_{r}^{p} UrYrj - \sum_{r}^{p} ViXij + U\text{o} \leq \text{oij} = 1, \ldots \ldots \ldots \text{n}$

$\sum_{i}^{p} ViXijo = 1,$

$UrYrj \geq 0$

Where:

y_{rj} = the amount of the output r produced by health facility j,

X_{ij} = the amount of the input i used by health facility j,

U_r = the weight given to the output r, (r = 1 . . . t and t is the number of outputs),

V_i = the weight given to the input I, (I = 1 . . . m and m is the number of inputs),

j_0 = the health facility under assessment.

E_0 equals to 1 if DMU_0 is efficient and E_0 is less than 1 if otherwise.

In DEA, technical efficiency is calculated as the best- observed practice achieved by the DMU on converting physical inputs into outputs, determined by the observed ratio of combined quantities of an entity's output to input.

Technical efficiency = the weighted sum of outputs produced /the weighted sum of inputs used

or TE=WSP/WSI

Where TE=Technical Efficiency

WSP= the weighted sum of outputs produced

WSI= the weighted sum of inputs used

The population of this study is the aggregate of all elements within the study area. It consists of the total of both the public and private HealthCare providers in Mubi metropolis.

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Convenience simple random sampling technique was used to sample fourteen (24) out of the total number of 51 (40 public and 11 private) Health care providers in Mubi metropolis from the research population respectively.

Techniques of Analysis

The technique of analysis used was Data Envelopment Analysis (DEA) in determining the comparative analysis of technical efficiency of both the public and private Health Care providers in Mubi-metropolis.

Results and Discussion

This section presents technical efficiency score result computed with Data Envelopment Analysis (DEA). The inputs variables are the number of health technicians (doctors, nurses, CHEW and JCHEW) and Number of Beds in the Hospitals/clinics. While the output variables were the inpatients, outpatients and child immunization.

Table 1 result revealed that only DMU 1 is technical inefficient in 2019 with the efficiency score of 0.521 as a result of improper utilization of resources and poor service delivery by the health technicians. while DMU 2, 3, 4, 5, 6 and 7 were technical efficient with the efficiency score of 1.000 respectively this implies that resources were fully utilized. In 2020 DMU 1 and 5 were technical inefficient with the efficiency score of 0.192 and 0.521 which implies poor services delivery because the values was too low, while DMU 2, 3, 4, 6 and 7 were technical efficient with the efficiency score of 1.000 respectively. In 2021 only DMU 1 is technical inefficient with the efficiency score of 0.536 as a result of improper utilization of resources and poor service delivery by the health technicians. While DMU 2, 3, 4, 5, 6 and 7 were technical efficient with the score of 1.000 respectively this implies that resources were fully utilized. In 2022 only DMU 1 is technical inefficient with the efficiency score of 0.426 as a result of improper utilization of resources and poor service delivery by the health technicians. While DMU 2, 3, 4, 5, 6 and 7 were technical efficient with the efficiency score of 1.000 respectively this implies that resources were fully utilized. In 2023 DMU 1, 2, 3, 4, 5, 6 and 7 were technical efficient with the score of 1.000 respectively this implies that resources were fully utilized.

Table1: Technical Efficiency for the Public Health providers in Mubi Metropolis

DMUs	2019	2020	2021	2022	2023
1	0.521	0.192	0.536	0.426	1.000
2	1.000	1.000	1.000	1.000	1.000
3	1.000	1.000	1.000	1.000	1.000
4	1.000	1.000	1.000	1.000	1.000
5	1.000	0.521	1.000	1.000	1.000
6	1.000	1.000	1.000	1.000	1.000
7	1.000	1.000	1.000	1.000	1.000
AV. TE	**0.932**	**0.816**	**0.933**	**0.918**	**1.000**

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Table 2 result revealed that DMU 1 and 3 were scale inefficient in 2019 with the efficiency score of 0.994, 0.974 as a result of improper utilization of resources and poor service delivery by the health technicians. while DMU 2, 4, 5, 6 and 7 were scale efficient with the efficiency score of 1.000 respectively this implies that resources were fully utilized. In 2020 DMU 1, 2, 5 and 6 were scale inefficient with the efficiency score of 0.980, 0.415, 0.753 and 0.470 respectively as a result of improper utilization of resources and poor service delivery by the health technicians while DMU 3, 4, and 7 were scale efficient with the efficiency score of 1.000 respectively this implies that resources were fully utilized. In 2021 DMU 2, 3, 4, 5and 7 were scale inefficient with the efficiency score of 0.230, 0.892, 0.673, 0.418 and 0.890 respectively as a result of improper utilization of resources and poor service delivery by the health technicians while DMU 1, and 6 were scale efficient with the efficiency score of 1.000 respectively this implies that resources were fully utilized. In 2022 DMU 1, 4 and 5 were scale inefficient with the efficiency score of 0.750, 0.655 and 0.370 as a result of improper utilization of resources and poor service delivery by the health technicians while DMU 2, 3, 6 and 7 were scale efficient with the efficiency score of 1.000 respectively this implies that resources were fully utilized. In 2023 DMU 2, 4, 5, and 6 were scale inefficient with the score of 0.309, 0.993, 0.860 and 0.498 respectively as a result of improper utilization of resources and poor service delivery by the health technicians while DMU 1, 3, and 7 were scale efficient with the efficiency score of 1.000 respectively this implies that resources were fully utilized.

Table2: Scale Efficiency for the Public Health care providers in Mubi Metropolis

DMUs	2019	2020	2021	2022	2023
1	0.994	0.980	1.000	0.750	1.000
2	1.000	0.415	0.230	1.000	0.309
3	0.974	1.000	0.892	1.000	1.000
4	1.000	1.000	0.673	0.655	0.993
5	1.000	0.753	0.418	0.370	0.860
6	1.000	0.470	1.000	1.000	0.498
7	1.000	1.000	0.890	1.000	1.000
AV. TE	**0.995**	**0.803**	**0.729**	**0.825**	**0.809**

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Table 3 result revealed that DMU 2, 4, 5, 6 and 7 were technical inefficient in 2019 with the efficiency score of 0.480, 0.100, 0.240, 0.250 and 0.320 respectively as result of inadequate health facilities and poor remuneration of the health technicians. While DMU 1, and 3, were technical efficient with the efficiency score of 1.000 respectively, where resources were fully utilized. In 2020 DMU 2, 4 and 5 were technical inefficient with the efficiency sore of 0.522, 0.164 and 0.484 respectively as result of inadequate health facilities and poor remuneration while DMU 1, 3, 6 and 7 were technical efficient with the efficiency score of 1.000 respectively where resources were fully utilized. In 2021 DMU 2, 5 and 7 were technical inefficient with the efficiency score of 0.514, 0.600 and 0.472 respectively while DMU 1, 3, 4, and 6 were technical efficient with the efficiency score of 1.000 respectively. In 2022 DMU 2 and 7 were technical inefficient with the efficiency score of 0.500 and 0.779 respectively while DMU 1, 3, 4, 5, and 6 were technical efficient with the efficiency score of 1.000 respectively. In 2023 DMU 2, and 5 were technical inefficient

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with the efficiency score of 0.696, and 0.812 respectively while DMU 1, 3, 4, 6 and 7 were technical efficient with the efficiency score of 1.000 respectively. DMU 2 throughout the period from 2019 to 2023 was not efficient compared to other Healthcare centers as a result of improper utilization resources and poor administration.

Table3: Technical Efficiency for the Private Health care providers in Mubi Metropolis

DMUs	2019	2020	2021	2022	2023
1	1.000	1.000	1.000	1.000	1.000
2	0.480	0.522	0.514	0.500	0.696
3	1.000	1.000	1.000	1.000	1.000
4	0.100	0.164	1.000	1.000	1.000
5	0.240	0.484	0.600	1.000	0.812
6	0.250	1.000	1.000	1.000	1.000
7	0.320	1.000	0.472	0.779	1.000
AV. TE	**0.484**	**0.739**	**0.798**	**0.897**	**0.930**

Authors Computation, 2024

Table 4 result revealed that DMU 2, 3, 4 and 5 were scale inefficient in 2019 with the efficiency score of 0.800, 0.160, 0.800 and 0.780 respectively while DMU 1, 6 and 7 were scale efficient with the efficiency score of 1.000 respectively. In 2020 DMU 3, 4, 5, 6 and 7 were scale inefficient with the efficiency score of 0.552, 0.952, 0.620, 0.180 and 0.489 respectively while DMU 1 and 2 were scale efficient with the efficiency score of 1.000 respectively. In 2021 DMU 2, 3, 4, 5, 6 and 7 were scale inefficient with the efficiency score of 0.986, 0.595, 0.167, 0.556, 0.357 and 0.884 respectively while only DMU 1 is scale efficient with the efficiency score of 1.000. In 2022 DMU 3, 4, 5, 6 and 7 were scale inefficient with the efficiency score of 0.729, 0.292, 0.875, 0.625 and 0.749 respectively while DMU 1 and 2, were scale efficient with the efficiency score of 1.000 respectively. In 2023 DMU 2, 3, 4, 5, 6, and 7 were scale inefficient with the score of 0.835, 0.706, 0.282, 0.690, 0.600 and 0.847 respectively while only DMU 1, is scale efficient with the efficiency score of 1.000.

Table 4: Scale Efficiency for the Private Health care providers in Mubi Metropolis

DMUs	2019	2020	2021	2022	2023
1	1.000	1.000	1.000	1.000	1.000
2	0.800	1.000	0.986	1.000	0.835
3	0.160	0.522	0.595	0.729	0.706
4	0.800	0.952	0.167	0.292	0.282
5	0.780	0.620	0.556	0.875	0.690
6	1.000	0.180	0.357	0.625	0.600
7	1.000	0.489	0.884	0.749	0.847
AV. TE	**0.791**	**0.680**	**0.649**	**0.753**	**0.709**

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Table 5 results shows that, the technical efficiency (TE) for both the Public and Private health care centers for some time from 2019 to 2022 revealed that public perform better than the private health care centers by moving closer to technical efficiency score of 1.000. While in 2023 most of the public hospitals were technically efficient with the efficiency score of 1.000 which is greater than the private health care centers with the efficiency score of 0.930. Although, from the period of 2019 to 2022 none of the public and private health care centers were fully technical efficient because most their efficiency scores is less than 1.000. In general, the summary of the mean scores for public health care centers s is higher than that of the private health care centers, with public having a score of 0.9198 and privates health care centers scores is 0.7696. The result indicates that from the period of 2019 to 2022 both the public and the private health care centers were not able to maximize outputs with inputs utilized. This study is in lined with the study conducted by Ibekunle (2019) The study revealed that, public health care centers were more efficient than private health care centers in terms of technical efficiency with the mean score of (0.858, 0.822 and 0.707) and private health care centers (0.690, 0.616 and 0.425).

Table5: Average Technical Efficiency for both Public and Private Health care providers in Mubi Metropolis

Year	Public	Private
2019	0.932	0.484
2020	0.816	0.739
2021	0.933	0.798
2022	0.918	0.897
2023	1.000	0.930
Mean	**0.9198**	**0.7696**

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Table 6 report the scale efficiency (SE) sore result computed with data envelopment analysis (DEA). With the input and output variables used the same with that of table 5. The scale efficiency normally shows the size at which both the public and private health care centers operate given the available inputs to determine outputs. The result also revealed that the scale efficiency score for both public and private health care centers from 2019 to 2023 none of them operate fully at efficiency level because their efficiency scores was less than the efficiency value (1.000). This is because of poor administrative management and improper utilization of resources in the health care centers. Though, throughout these periods the result revealed that public hospitals perform better than the private hospitals with efficiency scores for the public (0.995, 0.803, 0.729, 0.825 and 0.809) while for the private (0.791, 0.680, 0.649, 0.753 and 0.709) for the periods of 2019, 2020, 2021, 2022 and 2023 respectively. This contrary to the study conducted by Ibekunle (2019) which shows that it is not throughout the periods that public health care centers perform better than the private. This because in his study around 2009, 2011 and 2014 which shows that privates are more efficient than the public health care centers with efficiency score for private was (0.875, 0.854 and 0.896) and for the public (0.871, 0.793 and 0.779) respectively. This is because as a result of proper supervision and maximum utilization of resources at that periods. Generally, the mean annual scale efficiency score for public health care centers is (0.8322) which is higher than that of private hospitals score of (0.7164). This indicates that, the size at which both public and private health care centers operates are not the same in terms of inputs

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quantum (doctors, nurses, CHEW, JCHEW and health care centers beds) and outputs maximization (inpatients, outpatients and child immunization).

Table 6: Average Scale Efficiency for both Public and Private Health care providers in Mubi Metropolis

Year	Public	Private
2019	0.995	0.791
2020	0.803	0.680
2021	0.729	0.649
2022	0.825	0.753
2023	0.809	0.709
Mean	**0.8322**	**0.7164**

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Summary

This study examines technical efficiency of health care providers in Mubi metropolis (both public and private). The study used primary and secondary data from 2019 to 2023. Data Envelopment Analysis (DEA) technique was employed in the study. Table 5 result found out that both public and private hospital from 2019 to 2022 were moving closer to technical efficiency score of 1.000 While in 2023, most of the public hospitals were technical efficient with the score of 1.000 which is greater than the private hospital with the score of 0.930. The mean efficiency score for public health care centers was 0.9198 greater than that of private 0.7696. Table 6 result also found out that, the scale efficiency for both the public and private health care centers from 2019 to 2023 was none of them operate fully at efficiency level because their scores was less than 1.000. Even though, the scale efficiency score revealed that public health care centers perform better than the private ones. Lastly, the mean scale efficiency for public was 0.8322 which is greater than the private health care centers with score of 0.7164.

Conclusion

From the result of technical efficiency in 2023 which revealed that the technical efficiency of public health care providers was 1.000 and private health care centers was 0.930.The study therefore, concluded that public health care centers were more effective and efficient than the private health care centers. The study further concluded that public health care centers stands a better chance for healthcare delivery than the private health care centers, since the mean technical efficiency score for public health care centers is greater than that of private health care centers. In the same vein, the study shows that public health care centers are more efficient in terms of size at which they operate than the private health care providers in Mubi metropolis with the score of (0.8322) for public and (0.7164) for privates' health care providers.

Recommendations

The study therefore, recommends that both the public and private health care providers should train, monitor their workers so as to attain full efficiency level in Mubi metropolis. Secondly, both hospitals should adopt

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modern administrative technique and strict supervision for better services that will lead to higher performance and service delivery.

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