African Journal of Applied Research
Vol. 4, No. 1 (2018), pp. 106-119
http://www.ajaronline.com
http://doi.org/10.26437/ajar.04.0.1.2018.04

INVESTIGATING EFFICIENCY BASED ON THE HOSPITALS SIZE: AN APPLICATION OF A NON-PARAMETRIC APPROACH TO THE PRIVATE HOSPITALS IN TANZANIA

Bwana K.M.

Department of Accountancy, College of Business Education – Dodoma Campus, P. o. Box 2077 Dodoma, Tanzania.
kembo211@gmail.com

ABSTRACT

The paper contributes on understanding the most performing category of hospitals and operation in relation to the size (scale efficiency) taking the case of private hospital in Tanzania. Using the sample of 34 private not for profit (PNFP) hospitals, the effect of hospitals size on efficiency was investigated. Data were extracted from respective annual hospital's report from 2009 -2013. Data Envelopment Analysis (DEA) model was employed to compute efficiency based on the hospitals size. Findings revealed an average of variable return to scale technical efficiency (VRSTE) scores for the large hospitals is 98.8%, meaning hospitals could have produced 1.2% more outputs with the same volume of inputs. Average VRSTE score for medium and small hospitals is 79.45% and 88.6% respectively. Large private hospitals are more efficient compared to their medium and small counterparts. 77.7% of large private hospitals were efficient, meanwhile 47.05% and 62.5% of medium and small hospitals respectively were found to be efficient. However, the average scale efficiency of large hospitals is 91.2 %. Further, medium and small private hospitals could reduce their sizes by 19.05% and 3.5% respectively to become scale efficient. The study recommend medium hospitals with increasing return to scale (IRS) should increase scale of their activities to enjoy economies of scale while the hospitals experiencing decreasing return to scale (DRS) should reduce the inputs to avoid diseconomies of scale. Policy makers should focus on modeling the size of the hospitals against their respective scale of activities. Improvement in efficiency based on the hospitals size will prevent loss of scarce hospitals resources caused by scale inefficiency.

Keywords: *efficiency, hospitals size, non-parametric, Tanzania*

INTRODUCTION

Economic system is said to be more efficient than another (in relative terms) if it can provide more goods or services for society without using more resources. Considering the health care delivery which is the case of this study, healthcare system is said to be efficient if no extra hospitals' output/service can be realized given the available healthcare resources. Specifically, hospitals industry or health sector is said to be economically efficient if no patient can be made healthier (treated well) without making another patient worse off (poorly managed), this is what economists termed as the Pareto efficiency. No productivity of additional output (such as number of inpatients and outpatients, number of surgeries, number of births etc.) can be produced

African Journal of Applied Research
Vol. 4, No. 1 (2018), pp. 106-119
http://www.ajaronline.com
http://doi.org/10.26437/ajar.04.0.1.2018.04

without increasing the amount of the hospitals inputs (such as hospitals' beds and number of employees) or decreasing of another output. Alternatively, Production of the hospitals outputs proceeds at the lowest possible per-unit cost.

According to Hollingsworth et al., (2008) systematic review of the previous studies conducted on hospitals efficiency and productivity largely emanate from developed countries. However, in recent decades there have been a few studies from developing countries, to mention the few Osei et al., (2005) analyzed technical efficiency on Ghana's hospitals; Yawe (2010) examined technical efficiency of district hospitals in Uganda; Peckan (2011) assessed the efficiency and profitability in Turkey. Technical efficiency of hospitals in Kenya was analyzed by Kirigia et al., (2004). In another study, Bwana (2015) analyzed technical efficiency of faith based hospitals was analyzed in Tanzania. The ministry of health, through the regional secretariat, facilitates and supports provision of health services at the council level. Normally the system follows a pyramidal referral system operating upward (referral or national) from the lowest (village) level. The capacity of the health facility and types of services provided at each level, arranged from the bottom upwards, for example: Village level -Village health posts; Ward level-Community dispensaries; Divisional level-Rural health centers; District level-District/District designated hospitals; Regional level-Regional hospitals; Zonal level- Referral/Consultant hospitals; National level-National and specialized hospitals. The Tanzanian health system regards government as the main provider and financier of health services in the country, with a particular emphasis on the provision of primary health care services.
Parker and Newbrander (1994) contended the most key concern in health sector is to improve operating efficiency and make the best use of the available resources. In sub-Saharan Africa, hospitals absorb the greatest proportion of the total health expenditure, which is estimated at 45-69% of government health sector expenditures (Mills et al., 1993; Kirigia et al., 1998). Although this study involves private hospitals, the Government of Tanzania supports these hospitals by providing resources such as employees (medical personnel) and financial resources. For example, Government covers operating costs in hospitals operated under the partnership arrangement. Therefore it is very important to optimize the utilization of the available healthcare resources, as well as mobilizing additional resources for the Tanzania health system through efficiency savings. When hospitals experienced high level of technical inefficiency, then the substantial proportion of the available health resources are wasted, this will increase the existing shortage of resources experienced by many African countries (Zere et al., 2006). Therefore, general objective of this study is to determine efficiency based on the hospitals size. Specifically the study aims at:

i. Identifying the most performing category of hospitals
ii. Identifying the efficient hospitals from each category
iii. Examine the scale of hospitals' activity in relation to the hospitals size and establish optimization level.

This paper has been built on the study by Bwana (2015) where technical efficiency of private not for profit (PNFP) hospitals was examined in Tanzania. However, the study by Bwana (2015) did not focus on how efficiency relate to the size of hospitals. The result is expected to be useful to hospitals owners, researchers, administrators as well as policy makers at ministry of health,

ISSN: 2408-7920

African Journal of Applied Research
Vol. 4, No. 1 (2018), pp. 106-119
http://www.ajaronline.com
http://doi.org/10.26437/ajar.04.0.1.2018.04

community development, gender, Child and Elderly. The report helps in streamlining and balancing the relationships between the hospitals' size and scale of activities.

RESEARCH METHODOLOGY

Data and Sample

The sample size for this study covers 34 private hospitals from Tanzania, categorized into (8) eight small hospitals, (17) seventeen medium hospitals and (9) nine large hospitals. The study uses panel data, the data were obtained from respective hospitals' annual report for the period under scrutiny (2009 – 2013).The data set comprises five (5) years of panel data whereby the same hospitals in each group is traced over the five years.

Hospitals in this context were Bukumbi, Iambi, Igongwe, Ilembula, Lugalawa, Lutembo, Marangu, Mbesa Mission. Others were Mbozi Mission, Mkula, Ndolage, Nkinga, Nkoaranga, ST.Bernedict, UhaiBaptis, St. Corneleous and St. Raphael Hospitals, Biharamulo, Bunda, Huruma, Kilema, Rubya hospitals. Others were Sengerema, Sikonge, Sumve, Muheza hospital, Ilula, Makiungu, Mbalizi Evangelism, Peramio hospitals, Tosamaganga, Turiani, Mvumi, and ST. Gema hospitals. Generally, classification of hospitals based on sizes does not only allow the comparison between groups but also the analysis of hospitals with similar sizes within the group.

Inputs, Outputs and Model Selection

In total (8) eight outputs and inputs were employed in the study. The variables included as outputs were *total admission days, outpatient visits, outpatients' surgeries, total births* while *inputs were total number of labors and total number of beds*. To make sure that we avoid the possibility of having hospitals which are not efficient in the real sense (in the subset of efficient hospitals), in selecting the sample hospitals we deliberately omitted certain specialty hospitals so as to avoid this possibility (McKillop et al., 1999). Definitions of the variable selected are described in *Table 1*:

Table1. Inputs and Outputs Variables for DEA

Outputs	***Outputs operational definitions***
Total inpatients Days (Y_1)	Total number of days that inpatients stayed on hospitals' bed receiving inpatients services during the year (2009-2013)
Total outpatients visits (Y_2)	Total number of outpatients visited the department (2009-2013)
Surgical operation (Y_3)	Total inpatient and ambulatory Surgical operation (2009 -2013)
Total Births	Total number of births /delivery during the year (2009 – 2013)
Inputs	***Inputs operational definitions***
Hospitals beds (X_1)	Total number of used hospital beds during (2009-2013)
Full-time Equivalents (X_2)	Total Doctors and number of full-time physicians (2009-2013)

ISSN: 2408-7920

African Journal of Applied Research
Vol. 4, No. 1 (2018), pp. 106-119
http://www.ajaronline.com
http://doi.org/10.26437/ajar.04.0.1.2018.04

Outputs variables in this study have been adopted from hospital studies conducted by Hu and Huang (2004); Chang et al (2014); Pharm, (2010) the outputs are proxied by *outpatient visits*, *inpatient days and surgical operation performed*. According to Pharm,(2010) outpatient visits include scheduled visits to physicians and unscheduled visits to the emergency room of hospitals. However, due to the features of the services offered by hospitals, that means heterogeneity and joint production nature of the hospitals service sector the most commonly used measure of the hospitals output is the number of inpatient days produced, since it is considered uni-dimensional and medically homogenous (Chowdhury et al, 2011). Generally, inputs used to assess hospitals efficiency and productivity often classified into: recurrent resources *(represented by labor)* and capital resources *(represented by hospitals beds*). Therefore we follow previous hospitals studies by Pharm (2010); Chen (2006); Ferrari (2006) where such inputs were used in measuring hospitals performance.

Data Envelopment Analysis (DEA) as the Technique of Analysis

Data Envelopment Analysis (DEA) is a non-parametric approach, it is a linear programming method which picks best practice within a sample and measure efficiency based on difference between the observed and best practice units (Gannon, 2008). DEA has been widely applied in measuring efficiency where there are multiple inputs and outputs (Charnes, Cooper, and Rhodes. 1978), it was launched for the first time in 1978 by Charnes, Cooper and Rhodes. DEA is the piece-wise linear convex hull methods to frontier estimation, initially proposed by Farrell (1957). In hospitals studies the technique was first introduced by Banker, Conrad and Strauss in 1996, when data from hospitals in US was analyzed to examine hospitals efficiency. The study was followed by the study conducted by Grosskopf and Valdmanis in 1987 on sample of hospitals in California to measure performance. The method has been productively also employed in hospitals' studies conducted in Asia, Europe and North America so as to shed light on the hospital's efficiency. However, relatively few numbers of such studies have been conducted over recent years in the sub-Saharan African countries.

Charnes, Cooper and Rhodes (1978) proposed the Charnes, Coopeer and Rhodes (*CCR) model* that assumes input-oriented and Constant Return to Scale (CRS), while in subsequent articles different authors such as Banker, Charness and Cooper (1984) proposed the Banker, Charness and Cooper *(BCC) model* that assumes variable returns to scale (VRS), the variable return to scale (VRS) model was advocated to allow calculation of scale efficiency. Therefore, DEA Model has *Constant Return to Scale (CRS)* and *Variable Return to Scale (VRS)* assumptions. A CRS assumption advocates that there is proportional change in outputs due to change of inputs; on the other hand VRS advocates that returns will depend on the change in volume. On the other hand DEA may also have *outputs* or *inputs* orientation, inputs oriented assumption implies that management of the DMUs (in this case Hospitals) have no control over the outputs therefore they have influence on the inputs only and vice versa is true (Ozcan, 1992).

Therefore, since the hospitals under the scrutiny differ interns of size (large, medium and small hospitals), this paper pursues VRS assumptions and input orientation models. The model (VRS) was built on the assumption that change in inputs would lead to disproportionate changes in outputs. Scale efficiency is given by the ratio of constant return to scale efficiency (TE_{CRS}) to the ratio of variable return to scale efficiency (TE_{VRS}). Therefore, it implies that hospitals' output is

African Journal of Applied Research
Vol. 4, No. 1 (2018), pp. 106-119
http://www.ajaronline.com
http://doi.org/10.26437/ajar.04.0.1.2018.04

given and it can be produced by varying level of inputs. Technical efficiency (TE) given the assumption underlying this study; *input oriented measure* and *variable return to scale (VRS)* can be calculated by solving the following DEA LP problems.

Min θ_q such that:

Such that: $\sum_{j=1}^{n} x_{ij}\lambda \le \theta_q x_{iq}$, (i= 1 , 2,……..m)

$\sum_{j=1}^{n} \lambda_j y_{rj} \ge y_{rq}$ (r=1……s)

$\sum_{j=1}^{n} \lambda j = 1,$

λj ≥0 (j = 1, 2,……..…….n)

The objective of the Linear Programming problem is to find the *Min* θ_q that particularly minimizes inputs vector to Θ *Xiq*, while guaranteeing at least the output level of $Yj\lambda_j$.

θ_q is the input oriented technical efficiency (TEq) of $Hospital_{q(}DMU_q)$ in the input oriented – DEA Model, Y_{rq} is the produced amount of r^{th}*(r = 1, 2,…….s) for* $DMU_{qs.}$ X_{iq}*is the consumed amount of* i^{th} *inputs (I = 1, 2, ……m) for* $_{DMUj}$*(j= 1, 2, ……..n)* $.\lambda j$ is the weight assigned to the DMUj (j=1, 2, …..n). Dataset for this study was extracted from the annual report of respective hospitals. Data extracted was sorted and summarized with support of a computer program known as *excel*, and finally analyzed using the *Max DEA 5* to compute hospitals' efficiency.

RESULT AND DISCUSSION

Hospitals under the study were categorized into three groups based on their sizes namely; small, medium and large hospitals, the analysis covered five (5) years 2009 - 2013. The aim was to investigate if the hospitals' efficiency (performance) differs in relation to hospitals sizes. In establishing the category, this study follows Roh et al., (2012) who classified hospitals in the group of small, medium and large based on the number of beds in the hospitals. *(I.e. small hospitals: 0≤beds≤150, medium hospitals: 151≤beds≤250 and large hospitals: beds ≥251) (Ref: Table 2).* Input-oriented CCR and BCC of DEA models are applied in this study to calculate the overall technical efficiency under constant return to scale efficiency (CRTSE) technology; pure technical efficiency under variable return to scale efficiency (VRTSE) technology and scale efficiency (SE) of hospitals based on their sizes. Generally, the hospital with technical efficiency scores of 1 under CRTS indicates that the hospital is on the efficient frontier under constant returns to scale (CRS) technology while when the score is less than 1 it means the hospital is below the frontier. On the other hand the hospital with technical efficiency score of 1 under VRTS implies that the hospital is efficient under the variable return to scale (VRS), while when

ISSN: 2408-7920

African Journal of Applied Research
Vol. 4, No. 1 (2018), pp. 106-119
http://www.ajaronline.com
http://doi.org/10.26437/ajar.04.0.1.2018.04

the score is less than 1 it means the hospital is below the frontier. The constant return to scale (CRS) implies that the hospital has the best scale, while the increasing return to scale (IRS) indicates that hospital's inputs contribute to a more than proportionate increase in output. On the other hands decreasing return to scale (DRS) implies that an increase in hospital's inputs leads to a less proportionate increase in output.

Table 2: Efficiency (VRS) Summary – Small Hospitals (2009 – 2013)

Hospitals	**CRS TE**	**VRS TE**	**Scale**	**Return to Scale**
1	1.0000	1.0000	1.0000	-
2	1.0000	1.0000	1.0000	-
3	1.0000	1.0000	1.0000	-
4	0.7960	0.8810	0.9040	IRS
5	1.0000	1.0000	1.0000	-
6	0.6500	0.6650	0.9770	IRS
7	1.0000	1.0000	1.0000	-
8	0.4570	0.5460	0.8370	DRS
Max	**1.0000**	**1.0000**	**1.0000**	
Minim	**0.4570**	**0.5460**	**0.8370**	
Mean	**0.8630**	**0.8860**	**0.9650**	
SD	**0.209945**	**0.181046**	**0.061381**	

Table 2, presents technical and scale efficiency scores of individual eight (8) small hospitals' over the five years (2009-2013). Results of the technical and scale efficiency of small hospitals revealed that out of 8 small hospitals: Five (5) hospitals (62.5 %) manifested both CRSTE and VRSTE of 1 (100%) which means that 3 (37.5%) hospitals in this category were operating inefficiently over the same period. This implies doubling of health systems inputs to the five (5) small hospitals with CRSTE could lead to doubling of health services outputs. In other words, the size of these hospitals (62.5% of small hospitals) does not affect their productivity. Therefore, the marginal and average productivity of these hospitals remained the same/constant whether the hospitals were small or large. On the other hand, out of (3) three inefficient small hospitals (2) two have IRS (Increasing Return to Scale), meaning that these hospitals have a room to enjoy economies of scale. It further implies that hospitals are larger compared to their level of activities; therefore if more resources will be equally added then hospitals could produce more outputs. Generally, it can be argued that the mean variable return to scale (VRS) technical efficiency scores for the small private hospitals in Tanzania is 0.886 (88.6%), which means that

African Journal of Applied Research
Vol. 4, No. 1 (2018), pp. 106-119
http://www.ajaronline.com
http://doi.org/10.26437/ajar.04.0.1.2018.04

if operated efficiently the hospitals could have produced 12.2% more outputs for the same volume of inputs.

As far as scale efficiency is concerned the results showed that (5) fives small hospitals score scale efficiency of 100%, which implies they were operating at their optimal scale, neither experiencing economies of scale or diseconomies of scale. When the hospital is operating at its optimal scale it implies any equal increase in the inputs will result in the same amount of outputs, at this level the hospital is said to have constant returns to scale. The remaining 37.5% of hospitals in this category had the scale efficiency score of less than one (less than 100%), meaning they were not operating at their optimal scale of operation. However, it was observed that though three hospitals had scale efficiency score of less than one, two of them experienced increasing returns to scale (IRS). The average scale efficiency scores for small hospitals were 96.5% (and standard deviation of 0.0613). This implied that, inefficient hospitals with increasing return to scale could reduce their size by 3.5% without affecting their current level of outputs. The IRS (in the two small hospitals category) may have been caused by the fact that larger scale of particular activities are carried out in these hospitals and allowed or attract health managers/hospital administrators, and workers to specialize in their tasks and make use of more sophisticated health technologies (Totlego et al., 2010; Pindyck &Rubenfeld, 1995). The small hospitals with IRS ought to increase/expand scale of their activities or operation in order to become scale efficient. In the study by (McKillop et al., 1999) conducted in small and large hospitals in Northern Ireland, it was found that major overall causes of technical inefficiency for smaller hospitals were both pure technical inefficiency and scale inefficiency. Therefore, it can be argued that on average 62.5 % of private small hospitals in Tanzania are operating at their optimal scale of operation, and the remaining 37.5% not operating at their optimal scale (out of which 25% are experiencing IRS and have a room to enjoy the economies of scale). Generally, average scale efficiency scores for small hospitals were 96.5% which implied that, inefficient hospitals with increasing return to scale could reduce their size by 3.5% without affecting their current level of outputs, this is does not conform to findings in the study by (McKillop et al., 1999) in Northern Ireland, where it was found that small hospitals were experiencing decline in the scale efficiency.

Table 3, presents technical and scale efficiency scores of individual medium hospitals' during the five years (2009-2013), in this category (medium hospitals) there were 17 hospitals. Results of the technical and scale efficiency revealed that out of 17 medium hospitals:

African Journal of Applied Research
Vol. 4, No. 1 (2018), pp. 106-119
http://www.ajaronline.com
http://doi.org/10.26437/ajar.04.0.1.2018.04

Table 3: Efficiency (VRS) Summary – Medium Hospitals (2009 – 2013)

Hospitals	CRS TE	VRS TE	Scale	Return to Scale
1	0.5240	0.8360	0.6260	IRS
2	0.4020	0.6460	0.6210	IRS
3	1.0000	1.0000	1.0000	-
4	1.0000	1.0000	1.0000	-
5	0.2450	0.6120	0.4000	IRS
6	0.3400	0.5510	0.6170	IRS
7	0.4600	0.6120	0.7510	IRS
8	1.0000	1.0000	1.0000	-
9	0.8330	1.0000	0.8330	IRS
10	0.2980	0.5980	0.4980	IRS
11	1.0000	1.0000	1.0000	-
12	1.0000	1.0000	1.0000	-
13	0.3090	0.4530	0.6830	IRS
14	1.0000	1.0000	1.0000	-
15	0.9260	1.0000	0.9260	DRTS
16	0.7170	0.7270	0.9850	DRTS
17	0.4680	0.4720	0.9920	DRTS
Max	**1.0000**	**1.0000**	**1.0000**	
Mini	**0.2450**	**0.4530**	**0.4000**	
Mean	**0.67776471**	**0.794529**	**0.819529**	
SD	**0.30943085**	**0.206687**	**0.208657**	

Six (6) medium hospitals (35.29%) showed CRSTE score of 1 (100%) which means that 11 (64.71%) hospitals in this category were operating inefficiently over the sample period. 35.29 % of medium hospitals which manifested constant return to scale (CRS), implies doubling of health systems inputs lead to doubling of health services outputs. However, eight (8) medium hospitals showed VRSTE score of 1. The size of the six (6) hospitals (35.29%) under CRSTE did not

African Journal of Applied Research
Vol. 4, No. 1 (2018), pp. 106-119
http://www.ajaronline.com
http://doi.org/10.26437/ajar.04.0.1.2018.04

affect their productivity; the marginal and average productivity of these hospitals remained the same/constants whether the hospitals were small or large. On the other hand 8 (47%) hospitals were variable returns to scale technically efficient, with score of 100%, meanwhile the remaining 9(53%) hospitals were variable return to scale technically inefficient. It was observed that the mean of VRS technical efficiency scores for the private medium hospitals in Tanzania is 0.7945 (79.45%). This means, with reference to VRS models, the technical inefficient private medium hospitals in Tanzania could have produced 20.55% more outputs with the same volume of inputs if well operated.

As far as scale efficiency is concerned the results showed that 6 (35.29%) score scale efficiency of 100%, meaning that they were operating at their optimal size of operation, neither experiencing economies of scale or diseconomies of scale. When the hospital is operating at its optimal scale of operation it implies that any equal increase in the inputs will yield same amount of outputs, at this level the hospital is said to have constant returns to scale (CRSTE). The remaining 11 (64.7%) of hospitals in this category had the scale efficiency score of less than one (less than 100%), meaning they were not operating at their optimal level of operation. However, 8 (out of 11 with scale inefficiency) medium were experiencing increasing returns to scale (IRS). The average scale efficiency score for the private medium hospitals was 81.9%, implying scale inefficient hospitals could have reduced their size by 18.1% without affecting their existing level of outputs. As Pindyck & Rubenfeld, (1995) argued the IRS may have (in medium hospitals) resulted from coordination of particular activities carried out in hospitals, such activities may attract health administrators and health workers to specialize in their tasks and make use of more sophisticated health technologies. It is obvious that, 8 (eight) medium hospitals with IRS require expansion in scale of their activities or operation in order to make them scale efficient. The decreasing returns to scale (DRS) may arise due to the problem of coordinating tasks, maintaining line of communication between management and workers literatures assert that hospitals experiencing the DRS need to down-size their scale of operation of activities/operation in order to operate at the most productive scale size (Totlego et al., 2010). In this case, the 3 (three) medium hospitals which manifested the DRS should limit their activities to avoid experiencing diseconomies of scale. However, many of the medium hospitals have IRS, which implies that they have room of enjoying economies of scale. In other words, with the same level of activities the medium private hospitals in Tanzania, could have managed to produce 18.1% more of their current hospitals' outputs.

ISSN: 2408-7920

African Journal of Applied Research
Vol. 4, No. 1 (2018), pp. 106-119
http://www.ajaronline.com
http://doi.org/10.26437/ajar.04.0.1.2018.04

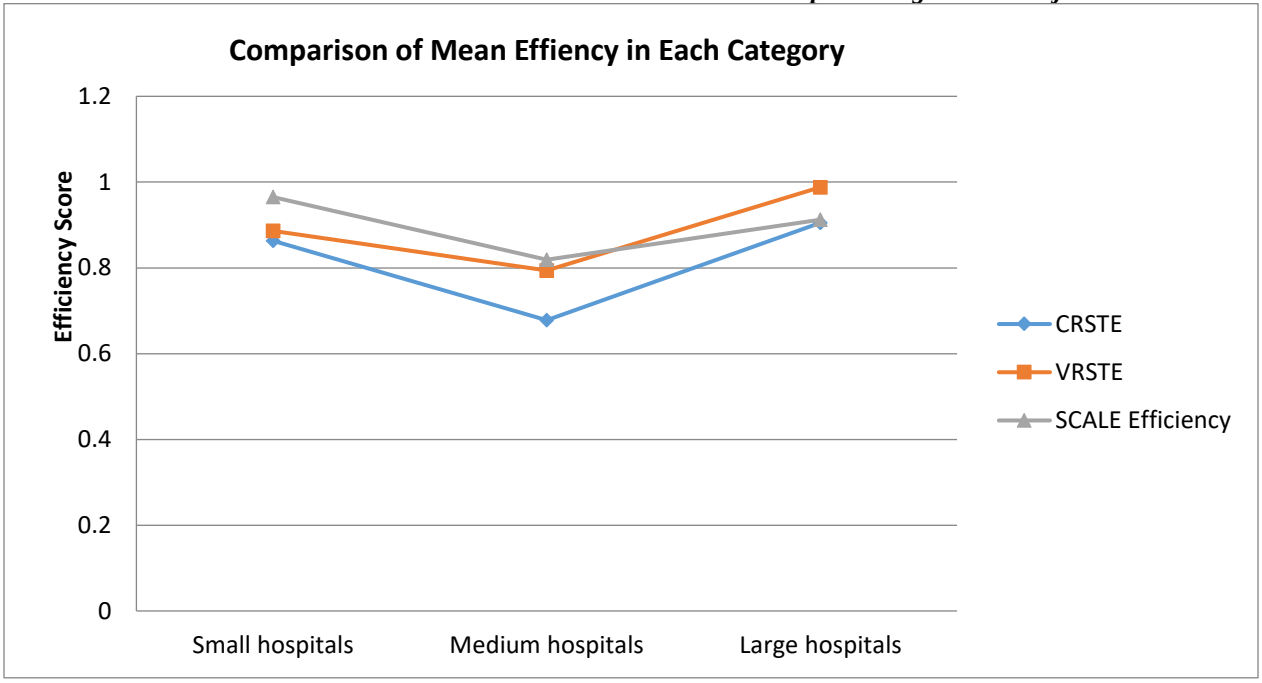

Figure 1: Mean Efficiency in Small, Medium and Large Hospitals

Table 4 summarizes the results of technical and scale efficiency of large private hospitals in Tanzania. There were 9 hospitals considered in this category of large hospitals. It was also observed that 55.5 percent of larger hospitals were experiencing constant return to scale technical efficiency (CRSTE), which implied the remaining (4) 44.45 percent were constant return to scale inefficient. However, all of these hospitals (scale inefficient) manifested increasing returns to scale. Results also revealed that out of 9 large hospitals. On the other hand, Seven (7) hospitals (77.77 %) manifested a variable return to scales technical efficiency (VRSTE) of 1 (100%) which means that 23.23% of hospitals in this category were operating inefficiently over the period under consideration. Five (55.5%) of private large hospitals showed constant return to scale (CRS), meaning doubling of health systems inputs lead to doubling of health services outputs. In other words, the size of these hospitals 5 did not affect their productivity.

Table 4: Efficiency (VRS): Summary – Large Hospitals 2009 - 2013

Hospitals	**CRS TE**	**VRS TE**	**Scale Efficiency**	**Return to Scale**
1	0.7970	1.0000	0.7970	IRS
2	0.9520	1.0000	0.9520	IRS
3	1.0000	1.0000	1.0000	-
4	1.0000	1.0000	1.0000	-

ISSN: 2408-7920

African Journal of Applied Research
Vol. 4, No. 1 (2018), pp. 106-119
http://www.ajaronline.com
http://doi.org/10.26437/ajar.04.0.1.2018.04

5	0.4600	0.8940	0.5140	IRS
6	0.9410	0.9950	0.9450	IRS
7	1.0000	1.0000	1.0000	-
8	1.0000	1.0000	1.0000	-
9	1.0000	1.0000	1.0000	-
Maximum	**1.0000**	**1.0000**	**1.0000**	
Minimum	**0.4600**	**0.8940**	**0.5140**	
Mean	**0.9050**	**0.9880**	**0.9120**	
SD	**0.17969287**	**0.035164**	**0.163186**	

General speaking, the average of VRSTE scores for the private large hospitals in Tanzania is 0.988 (98.8%). This means that if efficiently operated the large hospitals could have produced 1.2% more outputs for the same volume of inputs. On the other hand the average of CRSTE scores is 0.9050 (90.5%). Nevertheless, the large private hospitals in Tanzania are more efficient compared to their counterpart small and medium private hospitals which manifested the average VRSTE score of 88.6% and 79.45% respectively. Literatures record findings in this study were different with result of previous study by Nanyanjo and Okot (2013) where it was found that under the VRS the technical efficiency of large hospitals in Uganda was 91.7% which is less than that of private large hospitals in Tanzania (98.8 %). As far as scale efficiency is concerned the results showed that 5 (55.55%) score scale efficiency of 100%, meaning that they were operating at their optimal level of scale, they neither experiencing economies of scale or diseconomies of scale. When the hospital is operating at its optimal scale of operation it implies that any equal increase in the inputs will yield the same amount of outputs, at this level the hospital is said to have constant returns to scale. The remaining 44.45% of large hospitals had the scale efficiency score of less than one (less than 100%), meaning they were not operating at their optimal scale of operation. However, it was observed that four (4) inefficient hospitals were experiencing increasing returns to scale (IRS), this conforms to the result of the study found in Uganda by Nanyanjo and Okot (2013) where hospitals in district two and district five were experiencing IRS. This implied that if equal resources were to be equally added to these hospitals (with IRS) then they could have yielded more outputs. Therefore, these hospitals have a chance of enjoying the economies of scale and re-adjust their level of activities. According to Nanyajo and Okot (2013) in order to operate at productive size, a health facility experiencing DRS should scale down its inputs, and those exhibiting IRS should expand both inputs and outputs (scale of activities).

Therefore, it can be argued that on average scale efficiency of private large hospitals in Tanzania is 91.2 %, meaning that scale inefficient hospitals could reduce their size by 8.8% to become efficient (without affecting their current level of outputs), they have room to expand their levels of activities and enjoy the economies of scale. Generally, the overall change in technical

African Journal of Applied Research
Vol. 4, No. 1 (2018), pp. 106-119
http://www.ajaronline.com
http://doi.org/10.26437/ajar.04.0.1.2018.04

efficiency in large hospitals is mainly derived from the problems related to hospital size that is scale inefficiency. This result conforms to the findings of the study by McKillop et al. (1999) in Northern Ireland, where it was found that the primary cause of overall technical inefficiency for large hospitals is scale efficiency.

CONCLUSION AND RECOMMENDATIONS

The analysis of efficiency based on hospitals size, specifically aims include at: identifying the most performing group of hospitals *(small, medium or large hospitals);* identifying efficient hospitals in each group, and examine the scale of the activity in relation to hospitals size. Findings revealed that on average, large hospitals were relatively efficient compared to their small and medium counterparts *(Ref: Fig.1).* Based on the VRS model, inefficiency of large, medium and small private hospitals in Tanzania is largely caused by scale inefficiency. As far as scale efficiency is concern, small private hospitals were more scale efficient followed by large hospitals, the medium hospitals was the last one.

Result of the analysis of individual hospitals in each category indicates that 62.5 % of small hospitals were efficient under both CRSTE and VRSTE, which means the remaining 37.5% hospitals were operating inefficiently over the sampled period. On the other hand, out of three (3) inefficient small hospitals two (2) have IRS (Increasing Return to Scale), meaning that they have a room to enjoy economies of scale since the hospitals were too large compared to their scale of activity. As far medium hospitals are concern more than a half (50%) of medium hospitals were found to be inefficient, seventy two percent (72%) of inefficient hospitals manifested IRS, implying that they had a room to enjoy economies of scale. Large hospitals are the most performing category under the CRS and VRS technology; all inefficient hospitals under the two assumptions were still manifesting IRS. Result indicates that small private hospitals were performing almost closer to their optimal level of activities compared to their large and medium counterparts. As far as the optimal level of activity for each category is concern small, medium and large private hospitals could have reduced their size by 3.5%, 18.1% and 8.8% respectively without affecting their existing level of outputs.

The study suggests owners/ administrators of all large, medium as well as small private hospitals with increasing returns to scale (IRS) (but experiencing technical inefficiency) should ensure that hospitals are equally supplied with resources so as to enhance their level of activities and become efficient while those owners/administrators of hospital with decreasing return to scale (DRS) should scale-down activities (reduce inputs) to make the hospitals efficient. The study also recommends that administrators should adopt new management system which focuses on efficiency and capacity utilization. Future similar studies should focus on other techniques to estimate efficiency of private hospitals based on hospitals size.

REFERENCES

Banker, R.D., Charnes, A; and Cooper, W.W. (1984). 'Models of Estimating Technical and Scale Efficiencies in Data Envelopment Analysis '. *Management science 30. No.9. 1078 – 1092.*

Bjorn, E., Hagen, T., Iversen, T., & Magnussen, J. (2002). The effect of activity-based financing

on hospital efficiency: a panel data analysis of DEA efficiency scores 1992–2000 (Working Paper 8). Oslo. *Health Economics Research Programme, University of Oslo*.

Bwana, K. M. (2015). Measuring technical efficiency of faith based hospitals in Tanzania: An application of data envelopment analysis (DEA). *Research in Applied Economics, 7*(1), 1-12.

Chang, S.H., Hsiao, H.C., Huang, LH and Chang, H. (2014). Taiwan Quality Indicator Project and Hospital Productivity Growth, *Omega, Vol 39, pp14-22.*

Charnes, A, Cooper, W and Rhodes E. (1978). Measuring the Efficiency of Decision Making Units, *European Journal of Operation Research 2(6) 429 – 444.*

Chen, SN. (2006). Productive Changes in Taiwanese Hospitals and National Health Insurance, *The Services Industry Journal, Vol. 34, No. 6 pp 459 – 77.*

Chowdhury, H., Woodchips, W., & Laporte, A. (2011). Efficiency and Technological Change in Health Care Services in Ontario: An application of Malmquist Productivity Index with Bootstrapping. *International Journal of Productivity and Performance Management, 60*(7), 721-745.

Farrel M.J. (1957). The Measurement of Productive Efficiency. *Journal of the Royal Statistical Society Series – General* 120(3): 253 – 290.

Ferrari, A. (2006). Market Oriented Reforms of Health Services. A Non-Parametric Analysis, *The Services Industries Journal, Vol. 26, No.1 pp 1 -13*

Gannon, B (2008) Testing for variation in Technical efficiency of hospitals in Ireland, *the economic and social review, Vol 36 (3), pp273-94*

Gannon, B. (2008). Total Factor Productivity Growth of Hospitals in Ireland: A non-parametric Approach, *Applied Economics Letters, Vol 15 No 2, pp131-135.*

Hollingsworth, B. (2008). The Measurement of Efficiency and Productivity of Health Care Delivery. *Health Economics 17 (10) 1107 – 1128.*

Hu, J.L. and Huang Y.F. (2004). Technical Efficiencies in Large Hospitals: A Managerial Perspective. *International Journal of Management. 21: 4, pp506-513.*

Kirigia, J.M., Emrousnejad, A., Sambo, L.G., Munguti, N. and Liambila, W. (2004). Using Data Envelopment Analysis to Measure the Technically Efficiency of Public Health Centers in Kenya. *Journal of Medical Systems 28(2) pp 155-166.*

Kirigia, JM., Rushby, J., Mills, A. (1998). A cost analysis of Kilifi and Malindi District Hospitals in Kenya, *African journal of health science, Vol 5, pp79 – 84.*

McKillop, D.G and Glass, J.C (1999) Efficiency in Northern Ireland Hospitals, A non-parametric Analysis, *The Economic and Social Review, Vol. 30 No 2.*

Mills, A., Kapalamula, J., Chisimbi, S. (1993). The Cost of the District Hospitals: A Case Study in Malawi Bull, *World Health Organ, Vol 71, pp 329-339.*

Nanyyonjo, J and Okot, N (2013) Decentralization, Local Government Capacity and Efficiency of Health Services Delivery in Uganda, *Journal of African Development, Vol, 15, pp125 157.*

Osei, D., d'Almeida, S., George, M. O., Kirigia, J. M., Mensah, A. O., & Kainyu, L. H. (2005). Technical Efficiency of Public District Hospitals and Health Centers in Ghana: A Pilot Study. *Cost Effectiveness and Resource Allocation*, *3*(1), 9.

Ozcan Y.A. (1992). Sensitivity Analysis of Hospitals Efficiency under Alternative Output/ Input and Peer Groups: *A Reviewer, Knowledge and Politics 5: 1-29.*

Parker, D. and Newbrander, W. (1994) " Tackling Wastage and Inefficiency in the Health Sector", world Health Forum, Vol 15, pp107-13

Peckan, Y.A., Atan, M. and Beylik, U. (2011). Evaluation and Analysis on Profitability-Efficiency in Hospital Affiliated with Ministry of Health, *Scientific Research and Essay, Vol 6(28) pp5837-5845.*

Pharm, L.T. (2010). Hospitals Efficiency and Productivity in Vietnam, *Journal of Health of Organization and Management, Vol 25 (2) pp195 – 213.*

Pindyck, RS &Rubinfeld DL. (1995). *Microeconomics*, New Jersey, Prentice Hall.

Roh, C. Y., Park, C. & Moon, M. J. (2012). Economic Performances of US Non-Profit Hospitals Using the Malmquist Productivity Change Index. *Journal of Management and Marketing Research, 8*, 1-10.

Tlotlego, N., Justice, N., Sambo, LG., Zere, E and Kirigira, J.M. (2010). Assessment of Productivity of Hospitals in Botswana: A DEA Application, *International Archive of Medicine, Vol 3.*

Yawe, B. (2010). Hospital Performance Evaluation in Uganda. A Super efficiency Data Envelopment Analysis. *Zambia Social Science Journal. Vol. 1, No 1 pp79 – 105*

Zere, E., Mbeeli, T., Shanguki, K., Mandalhate C., Mutirua K., Tijivambi B, Kapenambili W. (2006). Technical Efficiency of District Hospitals: Evidence from Namibia using Data Envelopment Analysis, *Journal of Cost Effectiveness and Resource Allocation, Vol. 4, No 5.*

ISSN: 2408-7920