International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2013): 6.14 | Impact Factor (2013): 4.438

# Measuring Hospitals Efficiency using Data Envelopment Analysis Tool: Study on Governmental Hospitals Services at Ministry of Health – Khartoum State 2012

**Dr. Tarig Hassan Mohammad Alamin[1], Dr. Atif Ali Yassin[2]**

[1]Institute of Public Administration, Department of Statistics, Kingdom of Saudi Arabia

[2]**University** of Tabuk Faculty of Science, Department of Statistics Kingdom of Saudi Arabia

**Abstract:** ***Different Statistical tools for efficiency measurement were developed to assess governmental and non-governmental services in the late 1970s and early 2000s. One of these tools is data envelopment Analysis(nonparametric and nonlinear programming Tool) and its main objective is to measure and identify the efficiency of governmental service providers with the purpose of improving their services. The results revealed thatThe Global Technical Efficiencyof the ministry of Health- Khartoum State hospitals was (70.8%) which means there is still environmental factors and an internal management factors that create a gap and affects the performance of hospitals ( for example Politian interference, nepotism and favoritism). In detail , Local Pure Technical Efficiency of the ministry of Health- Khartoum State hospitals represents (84.3%) of performance which means that there is an internal management factors that create a gap and affects the performance of hospitals. Moreover, Scale Efficiency (SE) of the ministry of Health- Khartoum State hospitals represents (84%) of performance which means that there is environmental factors that create a gap and affects the performance of hospitals. Finally this paper advice ministry of health officials to adopt data envelopment analysis tool to measure the efficiency of hospitals services and take into account commensuration with the nature of the activities performed by these hospitals, and the diversity and differences between the various activities within each and every hospital. Moreover, the ministry must Develop a framework for a competitive project between hospitals based on the level of efficiency generated and thereafter award different prizes for the best performing hospital. Moreover, the final recommendation is that officials and stakeholders of governmental hospitals services at Ministry of Health –Khartoum state must train their staff and management to look at improving on aspects such as Politian interference, nepotism and favoritism that might affect the ministry efficiency.***

**Keywords :** Global Technical Efficiency Local Pure Technical Efficiency , Scale Efficiency , Constant Return to Scale Variable Return to Scale

## 1. Introduction

Statistician, Econometrician and management stakeholders developed different tools and indicators to measure human service productivity and efficiency. One of these indicators is partial productivity (ratios of output to input) which do not include all outputs and inputs. This may include labor per unit of a particular output ( e g: nurse per nine treatments) or capital/ or fuel/ or material per particular output. Partial productivity measures and recurrent cost per unit of output are used widely because they are simple to calculate, but they need to be interpreted with caution. On the other hand, these measures are always only partial in that they do not account for the relationships and trade-off between different inputs and outputs, hence this can be considered as significant drawback in their application to government services delivery( or any human service providers) which typically involves multiple inputs and outputs(1). The Steering Committee for the review of common wealth / state service provision, 1997 said that" Partial productivity measures can be used collectively to obtain a broad picture of any human services provider performance, but the presentation of large number of partial measures will typically be difficult to comprehend and interpret if some indicators move in opposite directions over a given period of time. This reinforces the value of more comprehensive summary measures of performance" .

Another approach was developed to cure the drawbacks of partial productivity in their application to show performance indicator of any service provider. This approach is the total factor productivity which combines all outputs and inputs into a comprehensive measure of overall productivity. One of its drawbacks as the Steering Committee for the review of common wealth / state service provision stated (1997) is that the total factor productivity technique is not generally applicable to service provision, because it requires a price for each output and input and outputs and inputs prices often can not be identified for many government services(or any human services). Thus, the steering committee, advice to use data envelopment analysis for measuring the performance of government service providers, because it is able to handle multiple services and inputs and doesn't require information on the price of services or inputs therefore it is applicable to government service provision( or any human service providers). Data envelopment analysis is a linear programming technique that identifies the apparent best providers of services by their ability to produce the highest levels of services with given set of inputs, or to produce given services with the least amount of inputs. Other service providers receive an efficiency score that is determined by their performance relative to that of the best performers. The technique can also determine whether the main source of inefficiency is scale of operations or the managerial capabilities and effort of service provider. One of the main advantages of data envelopment analysis is that it can

readily incorporate multiple inputs and outputs, and to calculate technical efficiency, only requires information on output and input quantities( not prices). This make it particularly suitable for analyzing the efficiency of government service providers and reveals the performance variations of the organization's processes , especially those providing human services where it is difficult or impossible to assign prices to many of the outputs. Moreover possible sources of inefficiency can be determined as well as efficiency level. Steering Committee for the review of common wealth / state service provision, 1997 mentioned that " one of the drawbacks of(DEA) is that it produces results that are particularly sensitive to measurement error. If one organization( hospital) can become an outlier that significantly distorts the shape of the frontier and reduces the efficiency scores nearby organizations( other hospitals ). Another drawback of (DEA) is that it only measure efficiency relative to best practice within the particular sample". Beside what mentioned above (DEA) scores are sensitive to input and output specification and the size of the sample( increasing the sample size will tend to reduce the average efficiency score, because including more organizations(hospitals) provides greater scope for (DEA) to find similar comparisons partners and conversely , including too few organizations(hospitals) relative to the number of outputs and inputs can artificially inflate the efficiency scores[(2)].

A major problem that facing services providers management is how to identify ways to improve their operations performance concerning whether there is an excess resources to provide their volume and mix of services provided to customers or whether there is a short fall in their volume of services to meet customers' requirements or specifications?[(3)]. In other words the service providers management are seeking ways with their available resources to maximize their outputs and profits or benefits with high quality provision to customers, or to minimize their resources without changing the volume of production and quality of resources provided to customers[(4)]. The main question is how to improve the efficiency of governmental service providers?. Translating this main question as an application to the case study of this research, we can say that the production process for each governmental hospital at Khartoum state take a set of inputs and produce a set of outputs. Each hospital has a varying level of inputs and gives a varying level of outputs, what is meant is that each hospital has a certain number of physicians, nurses, beds, …etc (the inputs) and there are a number of inpatients & outpatients treatments (the outputs) and hence the problem which the ministry of health – Khartoum state is facing now is that, if a given hospital (Z) is capable of producing (Y) units of outputs with (X) units of inputs , then other hospitals should also be able to do the same, if they were to operate efficiently to meet the strategic plans that has been stated by health policy makers for each and every hospital under study[(5)] . This creates the problem of how can we rank the efficient hospitals over their inefficient counterpart?.

Considering the above problem, the general objective of this paper is to measure and identify the efficiency of service providers like hospitals with the purpose of improving their services. The specific objectives are:

- To measure and identify the sufficiency of hospital`s inputs(General physicians, Specialist physicians, No. of Beds) compared to the ideal hospital.
- To measure and identify the sufficiency of hospital`s outputs (inpatients & outpatients) compared to the ideal hospital.
- To determine the overall Ministry of Health- Khartoum State efficiency in one single describing index.

Using the Data Envelopment Analysis(DEA), and depending on news paper issues and previous studies, this paper will examine the following Hypotheses:

1) There is excesses of some hospital`s inputs(General physicians, Specialist physicians, No. of Beds) compared to the ideal hospital.
2) There is shortfall of some hospital`s outputs (inpatients & outpatients) compared to the ideal hospital.
3) the causes of inefficiency at the inefficient hospitals is due to environmental and managerial factors.
4) there is a shortfall of General Physicians in most of the inefficient hospitals

Here in this paragraph we will present different studies to clarify and support the importance of data envelopment analysis tool implementation.One of the studies mentioned that The State government of Western Australia is currently working through a significant program of local government reform that has as a core objective a reduction in the number of local councils. The perception that there are economies of scale in service delivery is a key reason behind the State governments desire to see a reduction in the number of councils in Western Australia. The following article uses the technique of Data Envelopment Analysis to measure the technical and scale efficiency of councils in Western Australia. The average pure technical efficiency score for Western Australian councils was found to be 83 per cent, and the average scale efficiency score was found to be 94 per cent. This suggests that pure scale effects are not a major source of inefficiency. Detailed returns to scale analysis for the 73 councils where complete data was available revealed that 17 councils were operating at the optimal scale, 26 were operating below the optimal scale, and 30 were operating above the optimal scale (6). On the other hand, a study compared the productive efficiencies of four models of primary care service delivery in Ontario, Canada, using the data envelopment analysis (DEA) method. Particular care is taken to include quality of service as part of our output measure. The influence of the delivery model on productive efficiency is disentangled from patient characteristics using regression analysis. Significant differences are found in the efficiency scores across models and within each model. In general, the fee-for-service arrangement ranks the highest and the community-health-centre model the lowest in efficiency scoring. The reliance of our input measures on costs and number of patients, clearly favors the fee-for-service model. Patient characteristics contribute little to explaining differences in the efficiency ranking across the models (7) .

A published dissertation discussed the evaluation of the performance of health services in Khartoum locality using Data Envelopment Analysis (DEA). The dissertation used the number of clinical centers , private health institution,

number of vaccination and nutrition centers and numbers of reproductive health units as inputs. On the other hand, the dissertation used number of pharmacies and health services (Blood Bank, Radiology, Laboratories, Ultrasound) and number of coming units for each locality as outputs, during the period 2007-2009. The dissertation used input oriented and output oriented models and discovered inequality distribution of inputs and outputs between health services in Khartoum localities during the period 2007-2009.Therefore, the dissertation recommended redistribution of health resources in all localities so as to maximize its utilities and recommended more studies to be conducted in the future to know the real reasons of inefficiency in some localities and the effect of external factors that create inefficiency rates(8).

One of researchers said that despite its appeal for improving government, many state and local governments in USA have not developed performance-measurement systems, and even fewer use these systems to improve decision making. This study examines the factors that affect the utilization of performance measurement, based on the results of a national survey of state and local government officials. The goals of the study were to provide better information on the patterns of usage of performance measurement and to use this information to develop an elaborated model of the factors presumed to affect utilization. Using distinctions from the policy and evaluation literature, hypotheses were tested and confirmed: Policy adoption is driven more heavily by factors from rational and technocratic theory, whereas actual implementation is influenced by factors addressed by political and cultural considerations(9).

## 2. Material and Methods

Data Envelopment Analysis(DEA)was used as a tool to measure the efficiency of governmental hospitals services at Ministry of Health –Khartoum state 2012. In general there is two main techniques for measuring technical efficiency, deterministic and stochastic techniques. Data Envelopment Analysis abbreviated as(DEA) is a deterministic and a nonparametric linear programming method for evaluating efficiency of any organizations. The DEA materials and methodsare based on a mathematical model developed by Charnes et al. (1978). However, according to Barr et al. (1999), since then several different mathematical programming DEA models have been proposed in the literature. Each of these models seeks to establish how the n DMUs (decision making units) determine the envelopment surface (the best practice efficiency frontier). The geometry of this envelopment surface depends on the specific DEA model adopted. In order to make a detailed analysis of inefficient units and take corrective actions to improve their performance, this paper considers both the CRS assumption and the VRS assumption in estimating the efficiency indices as discussed below.

Let us first assume that there are constant returns to scale, we can then formulate the following model:

$$\underset{\text{Min}}{l_0 - \varepsilon\left[\sum_{i=1}^{m} S_i^- + \sum_{r=1}^{s} S_r^+\right]} \quad (1)$$

$$\text{Subject to: } \sum_{f=1}^{N} \lambda_f x_{if} = l_o x_{if_o} - S_i^- \quad \text{where } i = 1...m$$

$$\sum_{f=1}^{N} \lambda_f y_{rf} = S_r^+ + y_{rf_o} \quad \text{where } r = 1...s$$

$$\lambda_f \geq 0,\ f = 1...N,\ S_i^-,\ S_r^+ \geq 0 \ \forall \text{ i and r}$$

Where $x_{if}$ and $y_{rf}$ are levels of the ith input and rth output, respectively for DMU $f$. N is the number of DMUs. $\varepsilon$ is a very small positive number (non-Archimedean) used as a lower bound to inputs and outputs. $\lambda_f$ denotes the contribution of DMU $f$ in deriving the efficiency of the rated DMU $f_o$ (a point at the envelopment surface). $S_i^-$ and $S_r^+$ are slack variables proxying extra savings in input i and extra gains in output r. lo is the radial efficiency factor that shows the possible reduction of inputs for DMU $f_o$. If $l_o^*$ (optimal solution) is equal to one and the slack values are both equal to zero, then DMU $f_o$ is said to be efficient. When $S_i^-$ or $S_r^+$ take positive values at the optimal solution, one can conclude that the corresponding input or output of DMU $f_o$ can improve further once input levels have been contracted to the proportion $l_o^*$.

If a convexity constraint is incorporated in model (1), the following VRS version of the DEA model can be written as follows:

$$\underset{\text{Min}}{l_o - \varepsilon\left[\sum_{i=1}^{m} S_i^- + \sum_{r=1}^{s} S_r^+\right]} \quad (2)$$

$$\text{Subject to: } \sum_{f=1}^{N} \lambda_f x_{if} = l_o x_{if_o} - S_i^- \quad \text{where } i = 1...m$$

$$\sum_{f=1}^{N} \lambda_f y_{rf} = S_r^+ + y_{rf_o} \quad \text{where } r = 1...s$$

$$\sum_{f=1}^{N} \lambda_f = 1$$

$$\lambda_f \geq 0,\ f = 1...N, S_i^-, S_r^+ \geq 0 \ \forall \text{ i and r}$$

This model differs from model (1) in that it includes the so-called convexity constraint, $\sum_{f=1}^{N} \lambda_f = 1$ which prevents any interpolation point constructed from the observed DMUs from being scaled up or down to form a referent point which is not permissible under the VRS. In this model, the set of $\lambda$ values minimise $l_o$ to $l_o^*$ and identify a point within the VRS model whose input levels reflect the lowest proportion of $l_o^*$. At $l_o^*$, the input levels of DMU $f_o$ can be uniformly contracted without detriment to its output levels. Therefore,

DMU $f_o$ has efficiency equal to $l_o^*$ . The solution to model (2) is summarized in the following fashion: DMU $f_o$ is pareto-efficient if $l_o^*$ =1 and $S_r^{+*} = 0,\ r = 1...s,\ S_i^{-*} = 0,$ $i = 1...m$. Technical efficiencies assessed under VRS are referred to as pure technical input efficiency as they are net of any scale effects.

If the convexity constraint in model (2) is dropped, one obtains model (1), which can generate technical input efficiency under the CRS assumption. This implies that pure technical input efficiency of a DMU is always greater or equal to its technical input efficiency. Under both CRS and VRS assumptions, the resulting scale efficiency can be measured since in most cases, the scale of operation of the firm may not be optimal. The firm involved may be too small in its scale of operation, which might fall within the increasing returns to scale part of the production function. Similarly, a firm may be too large and operate within the decreasing returns to scale part of the production function. In both cases, efficiency of the firms may be improved by changing their scale of operation. If the underlying production technology follows constant returns to scale technology, then the firm is automatically scale efficient. Under CRS and VRS assumptions, technical efficiency scores for each method can be compared. The resulting ratio illustrates scale efficiency which is the impact of scale size on the productivity of a DMU. Formally, the scale input efficiency of DMU $f_o$ is given as $(TIE / PTIE)$.Where, TIE and PTIE are technical input efficiency and pure technical input efficiency of DMU $f_o$, respectively.Since pure technical efficiency is always greater or equal to technical efficiency, it means that scale efficiency $(TIE / PTIE)$ is less or equal to unity. If technical efficiency and pure technical efficiency of a DMU are equal, then scale efficiency is equal to one. This means that irrespective of scale, size has no impact on efficiency. If CRS is less that VRS then scale efficiency will be below unity meaning that the scale of operation does impact on the productivity of the DMU.

## 3. Study Population

every and each governmental hospital(48 hospital) at Khartoum State is considered to be an element under study, and hence all governmental hospitals at Khartoum Stateconstitute the population of this study.

## 4. Sample Size & Sampling Method

To measure efficiency, the minimum sample size of hospital needed to achieve the objectives is (15) out of (48) hospital under study depending on the selection of hospital inputs and outputs{(3 inputs +2 outputs)X3= 15}. Inputs are General physicians, Specialist physicians , and No. of Beds, and outputs are inpatients and outpatients. On the other hand, Cluster Random Sampling method has been used. Khartoum state was divided into three categories: Khartoum North, Omdurman and Khartoum and there after, data was collected from these three clusters .The following table shows the names of hospital that selected randomly and proportionally from each category(Khartoum North, Omdurman and Khartoum):

**Table 1:** Hospitals Sample Size

| Ser | Hospital Sample |
|---|---|
| 1 | Academy |
| 2 | Azonn, Anf & Hangara |
| 3 | Sharig Al- Nile |
| 4 | Ibn - Sina |
| 5 | Oamadopan |
| 6 | Omdurman Al-talimy |
| 7 | Abusad |
| 8 | Bahri Al-talimy |
| 9 | Alkbashi |
| 10 | Al- mantig Al-hara |
| 11 | Al-Srorab |
| 12 | Jabal- Aolia |
| 13 | Al-Turky |
| 14 | Hawadis Al-atfal |
| 15 | Alno |

**Data collection**

To measure the efficiency of hospitals, the secondary data about Khartoum governmental hospital's inputs(General physician, Specialist physician, Beds) and outputs (inpatients and outpatients) were collected for each and every element of the sample(15 hospitals) under study and note that this data is for the first (6) months of the year(2012).

**Statistical Analysis**

To measure, analyze and improve the technical efficiency of Khartoum governmental hospital's a non parametric approach that calculates efficiency level by doing linear program for each unit(hospital) in the sample was used and averages of hospitals efficiency between (0-----100%) was calculated using DEA software( learning version).

**Analysis and Results**

The relative efficiencies of (15) hospitals were evaluated with CCR and BCC models and Scale efficiency($\frac{BCC}{CCR}$) with an objective function of Input Minimization(Input Oriented) and Output Maximization (output Oriented)using DEA software( learning version) . Look at the details of (DEA) approach stated in chapter three.

In the Global Technical Efficiency (CCR) model, the No. of efficient DMUs (hospitals) with (100%) are (5) hospitals only : Al-Srorab Hospital, Ibn – Sina Hospital, Sharig Al-Nile Hospital, Hawadis Al-atfal Hospital, Azonn, Anf & Hangara Hospital. The hospital with the lowest efficiency is Al- mantig Al-hara Hospital (12%) efficient , Alkbashi Hospital(15%) efficient, Alno Hospital (44%) efficient, Omdurman Al-talimy Hospital(44%) efficient, Academy Hospital(46%) efficient, Bahri Al-talimy(67%) efficient, Abusad Hospital (70%) efficient, Al-Turky Hospital (87%) efficient, Jabal- Aolia Hospital(87%) efficient, Oamadopan Hospital(89%) efficient respectively.

The formulation of BCC model estimate the local pure technical efficiency of hospitals at a given scale of operation. The hospitals with the (100%) pure technical efficiency are (6) hospitals while only (5) hospitals are (100%) Global Technical efficient. Alno Hospital is the lowest local pure technical efficient(44%), then Academy Hospital with (46%) pure Technical efficiency. The local pure technical efficiencies of other hospitals shows in table (2).

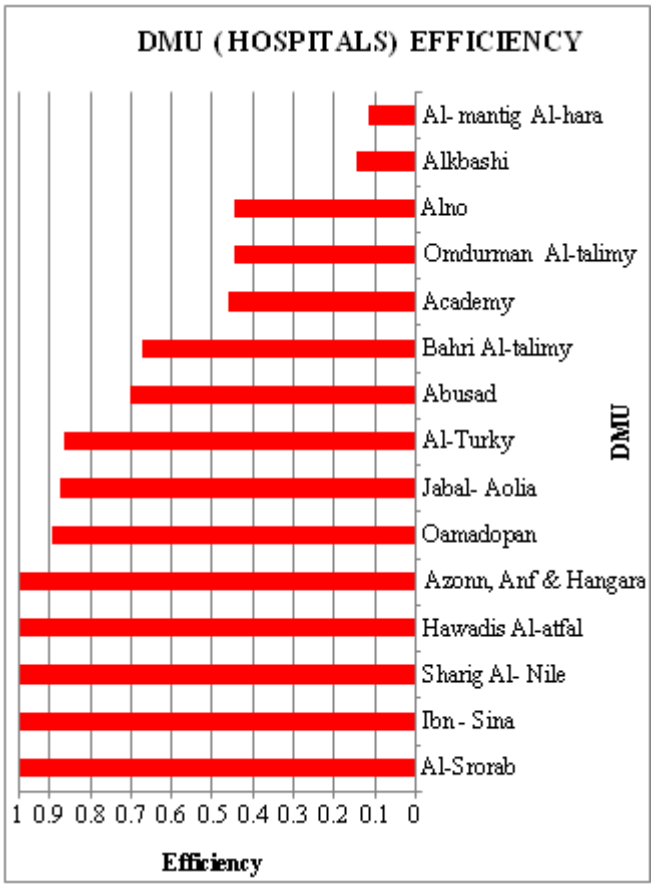
A scale efficiency of hospitals can be defined as the ratio of the Global technical efficiency from CCR model to the Local Pure Technical efficiency from the BCC model and it is shown in table(3). Only (5) hospitals are (100%) scale efficient which means that these (5) hospitals(Al-Srorab, Ibn – Sina, Sharig Al- Nile, Hawadis Al-atfal, Azonn, Anf & Hangara) are most productive scale size hospitals and the hospitals with the lowest scale efficiency are Alkbashi hospital with (16%),and Al- mantig Al-hara hospital with (18%).

On the other hand, table (2) shows that for example, the Global efficiency of Academy Hospital is only (46%) in CCR Model and (46.06%) technical efficient from BCC model, and the scale efficiency of Academy Hospital is (99.9%) which is the ratio of the Global efficiency to the pure technical efficiency. This means that the inefficiency of The Academy Hospital is basically caused by the pure technical inefficiency rather than by scale inefficiency

**Table 2:**The Efficiency of Khartoum State Hospitals

| *Rank* | *DMU(Hospital)* | *Global Technical Efficiency* | *Local Pure Technical Efficiency* | *Scale Efficiency* |
|---|---|---|---|---|
| 1 | Al-Srorab | 100% | 100% | 100% |
| 1 | Ibn - Sina | 100% | 100% | 100% |
| 1 | Sharig Al- Nile | 100% | 100% | 100% |
| 1 | Hawadis Al-atfal | 100% | 100% | 100% |
| 1 | Azonn, Anf & Hangara | 100% | 100% | 100% |
| 6 | Oamadopan | 89.28% | 91.89% | 97.15% |
| 7 | Jabal- Aolia | 87.48% | 90.07% | 97.12% |
| 8 | Al-Turky | 86.76% | 87.16% | 99.53% |
| 9 | Abusad | 70.43% | 74.55% | 94.47% |
| 10 | Bahri Al-talimy | 67.11% | 100% | 67.11% |
| 11 | Academy | 46.03% | 46.04% | 99.99% |
| 12 | Omdurman Al-talimy | 44.37% | 75.92% | 58.45% |
| 13 | Alno | 44.36% | 44.38% | 99.96% |
| 14 | Alkbashi | 14.49% | 92.48% | 15.67% |
| 15 | Al- mantig Al-hara | 11.56% | 62.28% | 18.57% |
| Ministry of Health -Khartoum State | | 70.79% | 84.32% | 83.96% |

GraphNo.1: Hospitals Efficiency




The advantage of DEA model not only provide an efficient score for each Hospital, but also indicates by how much and in what areas an inefficient units needs to improve in order to be efficient. If a Hospital is found to be inefficient then it should be able to produce its current level of outputs with fewer inputs( inputs minimization) or generate a higher level of outputs given the same inputs( output maximization). Table (3) shows projection analysis for the inefficient hospitals.

**Table 3:** Projection Analysis

| Variables. | Input &Output | Input Minimization | | Efficiency &Peers | Output Maximization | |
|---|---|---|---|---|---|---|
| Academy Hospital | Actual | Target | Improvement (%) | 0.4603937 | Target | Improvement (%) |
| General Physicians | 15 | 4.2647845 | 71.57% | Peer Hospitals: Hawadis Al-atfal, Azonn, Anf & Hangara, Sharig Al- Nile | 9.2633423 | -38.24% |
| Specialist Physicians | 7 | 3.2227559 | 53.96% | | 7 | 0.00% |
| Beds | 220 | 101.28662 | 53.96% | | 220 | 0.00% |
| Inpatient | 2574 | 2574 | 0.00% | | 5590.8671 | 117.21% |
| Outpatient | 3280 | 3280 | 0.00% | | 7124.3372 | 117.21% |
| Al-Turky Hospital | Actual | Target | Improvement (%) | 0.8675899 | | |
| General Physicians | 25 | 12.984728 | 48.06% | Peer Hospitals: Hawadis Al-atfal, Azonn, Anf & Hangara | 14.966435 | -40.13% |
| Specialist Physicians | 20 | 14.085146 | 29.57% | | 16.234796 | -18.83% |
| Beds | 144 | 124.93295 | 13.24% | | 144 | 0.00% |
| Inpatient | 3553 | 3553 | 0.00% | | 4095.2527 | 15.26% |
| Outpatient | 5717 | 5717 | 0.00% | | 6589.5186 | 15.26% |
| Alno | Actual | Target | Improvement (%) | 0.4436247 | | |
| General Physicians | 27 | 2.4658845 | 90.87% | Peer Hospitals: | 5.5584924 | -79.41% |

| | | | | | | |
|---|---|---|---|---|---|---|
| Specialist Physicians | 5 | 2.2181235 | 55.64% | | 5 | 0.00% |
| Beds | 82 | 36.377225 | 55.64% | | 82 | 0.00% |
| Inpatient | 985 | 985 | 0.00% | | 2220.3453 | 125.42% |
| Outpatient | 1262 | 1262 | 0.00% | | 2844.7469 | 125.42% |
| Al- mantig Al-hara | Actual | Target | Improvement (%) | 0.1156392 | | |
| General Physicians | 7 | 0.8094745 | 88.44% | | 7 | 0.00% |
| Specialist Physicians | 5 | 0.499302 | 90.01% | | 4.317757 | -13.64% |
| Beds | 73 | 8.4416625 | 88.44% | | 73 | 0.00% |
| Inpatient | 270 | 270 | 0.00% | | 2334.8481 | 764.76% |
| Outpatient | 0 | 106.55451 | 999.90% | Peer Hospitals: | 921.43925 | 999.90% |
| Bahri Al-talimy | Actual | Target | Improvement (%) | 0.6711308 | | |
| General Physicians | 24 | 16.10714 | 32.89% | | 24 | 0.00% |
| Specialist Physicians | 33 | 11.676085 | 64.62% | | 17.397629 | -47.28% |
| Beds | 455 | 305.36453 | 32.89% | | 455 | 0.00% |
| Inpatient | 8129 | 8129 | 0.00% | | 12112.392 | 49.00% |
| Outpatient | 8920 | 8920 | 0.00% | Peer Hospitals: | 13291 | 49.00% |
| Omdurman Al-talimy | Actual | Target | Improvement (%) | 0.4437533 | | |
| General Physicians | 54 | 23.962677 | 55.62% | | 54 | 0.00% |
| Specialist Physicians | 47 | 15.589426 | 66.83% | | 35.130841 | -25.25% |
| Beds | 526 | 233.41422 | 55.62% | | 526 | 0.00% |
| Inpatient | 7569 | 7569 | 0.00% | | 17056.776 | 125.35% |
| Outpatient | 2885 | 3080.4066 | +6.77% | Peer Hospitals: | 6941.7103 | 140.61% |
| Oamadopan | Actual | Target | Improvement (%) | 0.8927699 | | |
| General Physicians | 10 | 2.2165321 | -77.83% | | 2.4827586 | -75.17% |
| Specialist Physicians | 5 | 3.3247981 | -33.50% | | 3.7241379 | -25.52% |
| Beds | 72 | 64.27943 | -10.72% | | 72 | 0.00% |
| Inpatient | 323 | 1433.8746 | 343.92% | | 1606.0966 | 397.24% |
| Outpatient | 3376 | 3376 | 0.00% | Peer Hospitals: | 3781.4897 | 12.01% |
| Jabal- Aolia | Actual | Target | Improvement (%) | 0.874802 | | |
| General Physicians | 16 | 2.2020878 | -86.24% | | 2.5172414 | -84.27% |
| Specialist Physicians | 5 | 3.3031318 | -33.94% | | 3.7758621 | -24.48% |
| Beds | 73 | 63.860548 | -12.52% | | 73 | 0.00% |
| Inpatient | 1333 | 1424.5306 | 6.87% | | 1628.4034 | 22.16% |
| Outpatient | 3354 | 3354 | 0.00% | Peer Hospitals: | 3834.0103 | 14.31% |
| Alkbashi | Actual | Target | Improvement (%) | 0.1449506 | | |
| General Physicians | 5 | 0.1549471 | -96.90% | | 1.0689655 | -78.62% |
| Specialist Physicians | 3 | 0.2324207 | -92.25% | | 1.6034483 | -46.55% |
| Beds | 31 | 4.4934673 | -85.50% | | 31 | 0.00% |
| Inpatient | 9 | 100.23531 | 999.90% | | 691.51379 | 999.90% |
| Outpatient | 236 | 236 | 0.00% | Peer Hospitals: | 1628.1414 | 589.89% |
| Abusad | Actual | Target | Improvement (%) | 0.7042618 | | |
| General Physicians | 13 | 1.9787614 | -84.78% | | 2.8096956 | -78.39% |
| Specialist Physicians | 6 | 2.4930495 | -58.45% | | 3.5399468 | -41.00% |
| Beds | 50 | 35.213092 | -29.57% | | 50 | 0.00% |
| Inpatient | 853 | 853 | 0.00% | | 1211.1972 | 41.99% |
| Outpatient | 1775 | 1775 | 0.00% | Peer Hospitals: | 2520.3694 | 41.99% |

## 5. Discussions

In general**The Global Technical Efficiency**of the ministry of Health- Khartoum State hospitals represents(70.8%) which means there is still environmental factors and an internal management factors that create a gap and affects the performance of hospitals ( for example Politian interference, nepotism and favoritism) Therefore, polices are highly needed to bridge and improve this gap.In detail , **Local Pure Technical Efficiency**of the ministry of Health- Khartoum State hospitals represents (84.3%) of performance which means that there is an internal management factors that create a gap and affects the performance of hospitals ( for example centralization of decisions) Therefore, polices are highly needed to bridge and improve this gap. Moreover, **Scale Efficiency (SE)** of the ministry of Health- Khartoum State hospitals represents (84%) of performance which means there is environmental factors that create a gap and affects the performance of hospitals( for example Politian interference, nepotism and favoritism) Therefore, polices are highly needed to bridge and improve this gap.

## 6. Conclusions

We advice ministry of health officials to adopt data envelopment analysis tool to measure the efficiency of hospitals services and take into account commensuration with the nature of the activities performed by these hospitals, and the diversity and differences between the various activities within each and every hospital. Moreover, the ministry must Develop a framework for a competitive project between hospitals based on the level of efficiency generated and thereafter award different prizes for the best performing hospital. Our final recommendation is that officials and stakeholders of governmental hospitals services at Ministry of Health –Khartoum state must train their staff and management to look at improving on aspects such as

Politian interference, nepotism and favoritism that might affect the ministry efficiency.

## References

[1] *Commonwealth of Australia (1997).Review of commonwealth/ state Service provision, ISBN: 064335332.*
[2] *Cooper WW, Seiford M, Tone K(2006): Introduction to Data Envelopment Analysis and its Uses. New York: Springer2006Wei, J., & Wang, L. (2000). The non-parametric approach to the measurement of efficiency: The case of China commercial banks. Journal of Financial Research, 3, 88–96*
[3] *Richard Webster, etc(1998) Comparing Techniques for Measuring the Efficiency and Productivity of Australian Private Hospitals, Working Papers in Econometrics and Applied Statistics No. 98/3Kiadaliri, etc (2011) Measuring Efficiency of General Hospitals in South of Iran, world applied sciences Journal 13(6).*
[4] *Wei, J., & Wang, L. (2000). The non-parametric approach to the measurement of efficiency: The case of China commercial banks.* Journal of Financial Research, 3, 88–96.
[5] Onyebuchi A, Arah TC, Klazinga NS. Updating the Key Dimensions of Hospital Performance: The Move Towards a Theoretical Framework. Third Workshop on Hospital Performance Measurement, Barcelona 13-14 June 2003
[6] Milliken, etc (2008) Comparative Efficiency Assessment of Primary Care Models Using Data Envelopment Analysis, ISSN: 0225-3860.
[7] James Fogarty and Amin Mugera1 (2011) Local Government Efficiency in Western Australia, Working Paper 1122, School of Agricultural and Resource Economics, University of Western Australia, Crawley, Australia
[8] Genawi, Khalid(2010) Measuring the performance of the health sector of Khartoum State using Data Envelopment Analysis. Thesis for achieving Ph.d. Sudan University of Science & Technology College of Science Department of Applied Statistics.
[9] Julnes and Holzer(2001) Promoting the Utilization of Performance Measures in Public Organizations, Public Administration Review • November/December 2001, Vol. 61, No. 6.