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AN EX-ANTE EVALUATION OF TECHNICAL EFFICIENCY OF GHANA'S PUBLIC HOSPITAL TO SUPPORT NATIONAL HEALTH INSURANCE SCHEME IMPLEMENTATION IN GHANA

Paul Boadu[1*], Elizabeth Adjoa Kumah[2], Theodore Oboo Antwi-Asare[3], Augustine Fritz Gockel[3]

[1]CSIR-Science and Technology Policy Research Institute, Agriculture, Environment and Medicine Division, P. O. Box CT 519, Accra, Ghana
[2]Teesside University, School of Health and Social Care, Middlesbrough, UK
[3]University of Ghana, Department of Economics, Legon, Ghana

ABSTRACT: *This paper assessed whether the public district hospitals in Ghana are technically efficient to meet the challenge of possible increase in health care demand by Ghanaians that might result from the introduction of the National Health Insurance Scheme.The Data Envelopment Analysis (DEA) approach was used to estimate the efficiency of 51 Public District Hospitals. The results show an average overall Technical Efficiency of 77.6%, pure Technical Efficiency of 84.5% and Scale Efficiency of 92.1%. Out of the 51 public district hospitals used in the study, 30 of them were purely technically inefficient. The results also indicate that in general a total of 102 Medical and Pharmacy Staff, 530 General Administrative Staff, 462 Nursing Staff and 830 beds are wasted or not utilized in health care delivery by the public district hospitals. This indicates that any immediate increase in health care demand as a result of the National Health Insurance Scheme will not necessitate an increase in health care expenditure by the government but instead health care management should be called upon to operate more efficiently. The study concludes that there is potential to improve access and/quality of care without injecting additional resources into the health sector.*

KEY WORDS: technical efficiency, allocative efficiency, input slacks, hospitals, health insurance

INTRODUCTION

Ghana adopted what is popularly referred to as the cash and carry system of health care financing in 1985, as part of the Social Sector Reforms of the Structural Adjustment Programme implemented in the1980s. In this system, healthcare costs were paid out-of-pocket at the point of receiving treatment. Consequently, those without the means to pay the often-prohibitive costs of visiting a health care facility were without access to any form of healthcare. The cost of other forms of health systems such as traditional medication tends to be prohibitively high. Consequently, certain attempts were made to redress these setbacks. This saw the implementation of the exemption policy in 1997 under which basic services for children under five years of age, women seeking antenatal care, the elderly over 75 years of age and victims of snakebites were treated free of charge.

Despite this improvement, the exemption policies still left much to be desired in terms of providing access to adequate healthcare for all Ghanaians. The hospital sector is a large consumer of health care resources. Although the percentage varies from country to country, hospitals in developing countries consume an average of 50 – 80 per cent of the public sector health resource (Barrnum and Kutzin, 1993). The efficiency of hospitals merits close attention and scrutiny because of their enormous consumption of resources.

Even though efficiency is accorded the central place in health policy of most countries, with no exception of Ghana, in practice much remains to be done. Literature indicates limited studies on the efficiency of hospitals in Ghana. This, perhaps, indicates that in practice much attention is not given to efficiency by health care administrators. In their study, Osei et al. (2005) found that none of the hospitals used for their pilot study were technically efficient in their operations. Jehu-Appiah et al. (2014) found that only about 23% of hospitals in their study were technical efficient in their operations. Based on the outcomes of the study, they posit the prudency to periodically examine the efficiency of hospitals to help efficient allocation of scare resources. With the implementation of National Health Insurance scheme, it is expected that the people of Ghana will be in the position to utilize health care services more frequently. This will necessitate an increase in government health expenditure. However, such policy in this direction should be based on a detailed understanding of the technical efficiency of hospitals. This study was therefore conducted to assess the efficiency of the public district hospitals in Ghana to help advice policy makers in ensuring the efficient utilization of scarce resources amidst the implementation of national health insurance scheme. Thus, this research comes in to help fill the knowledge gaps to facilitate the reform process of Ghana health service and the Ministry of Health in the face of scarce resources to provide universal coverage of healthcare for all the people of Ghana.

The main objective of the study is to determine how efficient government hospitals are in terms of conversion of scarce resources into the production of health care services**.** More specifically**,** the paper seeks to evaluate the technical and scale efficiency of public district hospitals in Ghana.

THE NATURE OF HEALTH INSURANCE SCHEME IN GHANA

National Health Insurance Scheme

The National Health Insurance Scheme is designed to replace the existing 'Cash and Carry' health financing system. This became necessary because the 'Cash and Carry' System was not within the means of most Ghanaians and many cannot access health care, resulting in preventable deaths (Quaye, 1991). The health insurance allows everybody to make contributions into a fund so that in the event of illness, contributors benefit from healthcare in accredited health facilities without paying for it out-of-pocket.

Nature of the National Health Insurance

The Government developed a policy framework to provide the general guidelines for the establishment of the National Health Insurance Scheme and has passed a law to provide the legal framework necessary to facilitate the establishment of the National Health Insurance Scheme. The

law makes provisions for all people living in Ghana to join a health insurance. There are three types of schemes available under the law, these are:

- The District-Wide Mutual Health Insurance Scheme.
- The Private Mutual Health Insurance Scheme.
- The Private Commercial Health Insurance Scheme.

To boost enrolment on the scheme, the Government supported the District Mutual Health Insurance Scheme concept. This was to ensure that opportunities are provided for all Ghanaians to have equal access to the functional structures of Health Insurance and to ensure that, Ghanaians do move from an unaffordable 'Cash and Carry' regime to an affordable Health Insurance Scheme. It was also to make the Health Insurance Scheme sustainable and to avoid any compromise of quality health care.

The District Wide Mutual Health Insurance Scheme

Each district is divided into Health Insurance Communities so that Health Insurance could be brought to the door step of all Ghanaians. A Health Insurance Community is any group of adults who live in the same geographical area and converge to register and vote at specifically pre-determined polling station in the area. A Health Insurance Committee was formed in each Health Insurance Community to oversee the collection of contributions and supervise its deposition into the District Health Insurance Fund. The highest decision making body on health insurance at the district level is made by the District Health Insurance Assembly. This body is responsible for preparing the constitution to provide the general guidelines for the operation of Health Insurance in the district.

National Health Insurance Premium and Disease Coverage

The government, having taken into account the varied socio-economic condition of the populace, came out with different rates to ensure affordability by all Ghanaians (Table 1.1). In addition, all residents in Ghana pay 2.5% Health Insurance Levy on selected goods and services to be put into a National Health Insurance Fund to subsidize fully paid contributions to the District Health Insurance Schemes. The Government came out with a minimum benefit package of diseases which every district-wide scheme must cover. This package covers about 95% of diseases in Ghana. Diseases covered among others are; Malaria, Diarrhea, Upper Respiratory Tract Infection, Skin Diseases, Hypertension, Diabetics and Asthma. However, all district-wide schemes have the right under the law to organize their schemes to cover as many diseases and services as they desire, provided it is approved by the National Health Insurance Council.

Certain diseases are, however, excluded from the benefit package. This was mainly because it may be too expensive to treat those diseases and therefore other arrangements are being considered to enable people get these diseases treated. Diseases currently not covered include: Optical aids, Hearing aids, Orthopaedic aids, Dentures, Beautification Surgery, Supply of AIDS drugs, treatment of Chronic Renal Failure, Heart and Brain Surgery, etc. All these constitute only 5% of the total number of diseases that attack Ghanaians (Ghana Health Service, 2006).

As stated earlier, contributions are payable in line with one's ability to pay. For the informal sector, community health insurance committees identify and categorize residents into social groups to enable individuals in each group pay in line with their ability to pay. By law, the core poor or indigents such as unemployed adults with no consistent financial support from identifiable sources are to be exempted from contributing to any District Mutual Health Insurance Scheme. Children under 18 years of age, whose parent(s) or guardian(s) pay their own contributions, are exempted from paying any contribution.

A social grouping validation team is also in place in all Districts/Sub-metropolis to ensure that, the core poor are listed for Government to pay their contributions from the National Health Insurance Fund. Residents who pay their contributions in full wait for at most six months before their Health Insurance Identification and Health Facility Attendance cards are issued to them to enable them access any public health facility or any private accredited health facility in Ghana for both inpatient and outpatient care in line with the scheme's benefit package. The six-month lag for first time entrants after full contribution is meant to avoid having only sick people contributing to the scheme and accessing treatment immediately after in order to safeguard the scheme from collapse at its inception.

Table 1.1: The contributions payable by the social groupings in the informal sector

Name of Group	Category	Who they are	Annual Minimum Contribution Payable
Core Poor	A	Adults who are unemployed and do not receive any identifiable and constant support from elsewhere for survival	Free
Very Poor	B	Adults who are unemployed but receive identifiable and consistent financial support from sources of low income	GH¢ 7.2
Poor	C	Adults who are employed but receive low returns for their efforts and are unable to meet their basic needs	
Middle Income	D	Adults who are employed and able to meet their basic needs	GH¢ 18
Rich	E	Adults who are able to meet their basic needs and some of their wants	GH¢ 48
Very Rich	F	Adults who are able to meet their needs and most of their wants.	

Source: http://www.modernghana.com/GhanaHome//report_content/NHIS.pdf

It is also to ensure that enough money is accumulated to take care of any possible huge cost burden which may occur at the beginning of the implementation of the Health Insurance Scheme. In

addition to the first entrants, those who renew their registration after 13 months after the expiry of the previous registration also wait for six months before benefitting from the package.

The Government came out with a painless way for workers in the formal sector to join the District-Wide Health Insurance Schemes through the enacted Law on Health Insurance. The law made it mandatory for 2.5% of workers social security contributions to be put into the National Health Insurance fund to be subsequently disbursed to the District Mutual Health Insurance Schemes as their contributions to the scheme. Children under 18 years of formal sector workers are also exempted from paying any contributions. The government believes that the idea to deduct workers contributions from their social security contributions instead of their salary earnings will provide free health insurance coverage for workers within the minimum benefit package; minimize the healthcare component of workers household budget to enable them have more disposable income during their working days; minimize the healthcare component of workers household budget when they go on pension to enable them receive free treatment within the minimum benefit package for the typical old age chronic diseases like diabetes and hypertension and also to have more disposable pension income to improve their general well being; and ensure that formal sector companies and organizations comply with payment of workers contributions to the SSNIT fund (Ghana Health Service, 2006).

THEORETICAL AND EMPIRICAL CONSIDERATION

Economists are concerned with efficiency as it aims at obtaining the best out of the available scarce resources. Efficiency measurement techniques can mainly be classified into: (i) Frontier (Data Envelopment Analysis and Stochastic Frontier Method) and (ii) Non-frontier estimations (Ratio and Regression Analysis).

Non-frontier measures

According to Bitran and Block (1992), measurement of efficiency through Ratio Analysis represents a calculation of a ratio relationship between variables. This is done using either;
(1) Input to output ratios (physical); or (2) Cost of inputs and outputs ratios; approximates economic efficiency.
The major limitations are:

- Each ratio is limited to only one input and output
- It cannot easily accommodate cases of multiple inputs and outputs.
- It also gives a static measure of efficiency, among others. And weights are difficult to be obtained

Regression analysis approach

In the past, regression approaches have been commonly used for measuring efficiency, because it is more comprehensive than ratio analysis and it can accommodate multiple inputs and outputs. Other advantages of regression analysis are that: the statistical significance can be determined and attached to the regression coefficients. Also, there is consideration of random error term in a

regression model and marginal impact estimation is made possible. Finally, regression approach is more familiar and better understood/accepted (Green, 1993).

The limitations of regression analysis include inability to identify sources and estimate the inefficiency amounts associated with these sources. Here, no clue as to what corrective action must be taken even when the dependent variable shows that inefficiencies are present. The second limitation is that an estimate of hospital cost function using regression technique results in a mean relationship that does not directly locate inefficient hospitals; hence as with Ratio Analysis, it requires that hospitals with arbitrary distance from the mean be labeled potentially inefficient (Bowlin, 1999).

These notwithstanding, numerous econometric regression approaches have been applied in studies on hospitals to identify economies of scale, marginal cost of patient care, and rates of substitution, efficiency scale size, or efficient rate of transformation simply because they reflect behaviour of both efficient and inefficient hospitals combined (Shearman, 1984; Evans et al, 2000).

Frontier measures

These measures are based on mathematical programming and econometric methods to produce an efficient boundary line to demarcate efficient decision making units from inefficient ones. The two principal methods under frontier analysis are: Stochastic Frontier Approach (SFA) and Data Envelopment Analysis (DEA).

Stochastic Frontier Approach (SFA)

In this approach efficiency measures are calculated relative to an efficient technology, which is generally represented by a frontier function. Folland and Hofler (1995) noted that in this method each organization is treated uniquely by assuming it to be affected by a potential shock to its ability to produce, hence since each firm can be potentially shocked, the firms' best possible practice, its frontier will be randomly shifted. The frontier function is therefore partially random, that is the frontier is a stochastic process; stochastic frontier. The SFA adopts a parametric function fitted to the data estimated using econometric approach. This approach requires assumptions about the statistical distribution of the inefficiencies.

Data Envelopment Analysis (DEA)

DEA is a linear programming methodology for evaluating relative efficiency of each production unit among a set of fairly homogeneous decision-making units (DMUs), e.g. district hospitals, health centers, etc. It sketches a production possibilities frontier (data envelop or efficient frontier) using combinations of inputs and outputs from best performing health facilities. Health facilities that compose the "best practice frontier" are assigned an efficiency score of one (or 100%) and are deemed technically efficient compared to their peers. The efficiency of the health facilities below the efficiency frontier is measured in terms of their distance from the frontier. The inefficient health facilities are assigned a score between one and zero. The larger the score the more efficient a health facility is. The technically inefficient health facility uses more weighted inputs per weighted output, or produces less weighted output per weighted input than those health facilities on the "best practice frontier".

Since hospitals and health centers employ multiple inputs to produce multiple outputs, their individual technical efficiency can be computed by solving a series of linear programme problems. DEA is the preferred method of efficiency analysis in the non-profit sectors due to the fact that:

- DEA enables simultaneous analysis of multiple inputs and output (in their natural units).
- DEA does not require the specification of the production and cost function of decision making units concerned.
- DEA provides the means of decomposing economic efficiency into technical and allocative efficiency, and further allows technical efficiency to be decomposed into scale efficiency and pure technical efficiency.
- No price data is required in the estimation.
- DEA allocates technical or Pareto efficiency in a manner consistent with economic theory than econometrics techniques that is based on mean (average) relationship reflecting a mixture of efficient and inefficient behaviors (Coelli et al; 1998).

Aside these merits, there are two major drawbacks of this method (Lovell 1993, Coelli et al, 1998). First, DEA is non-parametric. It does not capture random noise (e.g. epidemics, weather, and strike); as such any deviation from the estimated frontier is interpreted as being due to inefficiency. Second, it is non-statistical, in the sense that it is not possible to conduct statistical test of hypothesis regarding the efficiency and the structure of the production technology. Ferrier and Valdmanis (1996), however, argue that, these drawbacks may not be as serious as they initially seem. First, there is no a priori specification of the functional form of the technology, and as such specification error that might show up as a noise is ruled out. Secondly, as inputs and outputs are measured in their natural physical units, measurement error is most unlikely.

Empirical considerations

In recent past, studies on efficiency have been given wide consideration especially in the developed countries. Most of these studies used DEA to measure the efficiency of hospitals, agriculture productivity, banks, education and government expenditure. The extensive use of this approach is mainly due to its advantages over other approaches. Most of the studies on hospitals, which this study is related, used recurrent expenditure, number of beds, number of physicians and nurses as inputs- these are broadly categorized into labour, and capital supplies. The bulk of outputs of hospitals are captured by inpatient days, outpatient visits, total admissions and total discharge (Nuwbrander et al., 1997; Eyob, 2000; Osei et al., 2005; Etelviva De Fatima, M., 2002).

METHODOLOGY

Data

The data for the study was obtained from the Human Resource Unit of the Ministry of Health, and Center for Health Information Management, Policy, Planning, Monitoring and Evaluation Division of the Ghana Health Service. The data was mainly from secondary sources.

Population and sampling

The population for this study is made up of all hospitals and health care centers in Ghana. The hospitals and health care centers are categorized into community, sub-district, districts, regional, tertiary and national level health facilities (MOH, 1999). The sample for the study was chosen based on the availability of data on the various public hospitals in the country. The study focused mainly on 51 public district hospitals out of the 70 public district hospitals in the country (PPME, 2005). Efficiency scores were computed for e hospitals.

Estimation techniques

DEA model was used to estimate the efficiency scores of the public district hospitals. Under the assumption of constant returns to scale, the efficiency of each hospital was obtained by solving the following model (Charnes et al, 1978):

Model 1: DEA weights model, input-oriented, constant returns to scale.

$$Maxh_0 = \sum_{r=1}^{s} u_r y_{rj_O}$$

Subject to

$$\sum_{i=1}^{m} v_i x_{ij_O} = 1$$

$$\sum_{r=1}^{s} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} \le 0,\ j = 1,...,N$$

$$u_r, v_i \ge 0$$

Definition of variables

y_{ij} (r = 1... s) = observed amount of output r produced by hospital j

$x_{ij}(i = 1,...,m)$ = Observed level of input i used by hospital j

u_r = Weight given to output r

v_i = Weight given to input

n = number of hospitals

The first constraint indicates that the weighted sum of inputs for the particular firm equals one. The second implies that all firms are on or below the frontier, that is, those firms that are efficient are assigned an upper boundary value of one and those that are inefficient are assigned a figure

less than one based on the level of inefficiency the firm operates. The weights u_r and v_i are treated as unknowns and their weights are obtained in the linear programming solution.

The CRS assumption is only appropriate if all firms under consideration are operating at an optimal scale. When firms are not operating at an optimal scale, the technical efficiency can be decomposed into pure technical efficiency and scale efficiency, thus in a situation where the CRS assumption does not hold, the TE measure is mixed with scale efficiency.

To disentangle the effect of scale efficiency it became necessary to use a DEA model with a variable return to scale (VRS) assumption. To this end Banker et al (1984), developed an extension of the original CRS model. The linear programming problem in this case is expressed as follows:

Model 2: DEA weights model, input- oriented, variable returns to scale (VRS)

$$Maxh_0 = \sum_{r=1}^{s} u_r y_{rjo} + u_0$$

Subject to

$$\sum_{i=1}^{m} v_i x_{ij} = 1$$

$$\sum_{r=1}^{s} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} + u_0 \leq 0,\ j = 1,\ldots,N$$

$$u_r, v_i \geq 0$$

$$u_0 \geq or$$

$$u_0 \leq 0$$

The notations are the same as given in first model. The additional term corresponds to an intercept (Bjerek et al 1990) and is unconstrained in sign, the sign of u_o determines the returns to scale and $u_o < 0$ indicates increasing return to scale, $u_o = 0$ is for constant returns, and $u_o > 0$ is for decreasing returns to scale.

Variables: inputs and outputs

A total of seven (7) variables were used in the hospital DEA models. This is made up of four (4) inputs and three (3) outputs. The inputs are:

- Number of beds: The total number of beds found in the wards in each DMU.
- Number of Medical and Pharmacy Officers: The total number of Medical and Pharmacy Officers found in each DMU.
- General Administration: The total number of individuals responsible for the administrative work in each DMU. In addition, it includes medical laboratory administrative staff and other supporting workers such as drivers, cooks, gardeners, watchmen and cleaners.
- Nursing Administration: The total number of full time and enrolled nurses in each DMU.

The outputs include:

- Inpatient Days: The total number of days spent by patients in a particular hospital in the year 2006.
- Outpatient Visit: Total number of daily hospital visit made by those who are not admitted to the hospital.
- Number of Admissions: The total number of male and female admissions in each DMU for the year 2006.

DEAP Version 2.1 Computer Programme developed by Coelli (1996) was used to estimate the DEA models.

RESULTS AND ANALYSIS

Table 1 shows the descriptive statistics of outputs and inputs of 51 district hospitals used in this study. From the table, the hospitals in the country used a minimum of one (1) Medical and Pharmacy Staff, fourteen (14) General Administrative Staffs, four (4) Nursing staff , and 11 beds to produce a minimum output of 1145 Admissions, 1424 Inpatient Days and 4395 Outpatient Days.

Table 1: Descriptive Statistics of outputs and inputs used by the District Hospitals

Variables	Mean	Median	Standard Deviation	Minimum Value	Maximum Value
Outputs					
Total Admissions	4196.24	3959	2186.08	1145	12637
Inpatient Days	14487.39	13373	9770.95	1424	60576
Outpatient Visits	36989.12	31233	28311.18	4395	162254
Inputs					
Medical & Pharmacy Staff	8	5	8.82	1	44
General Administration Staff	61	53	31.00	14	149
Nursing Staff	47	36	45.03	4	304
Beds	89	69	49.27	11	287

Source: Author's estimation from Ghana Health Service Data

The district hospitals on the average use 8 Medical and Pharmacy staff, 61 General Administrative staff, 47 Nursing Administrative staff and 89 beds to produce average output of 4196.24 total hospital admissions, 14487.39 inpatient days and 36989 outpatient visits. As reflected in the large standard deviations figures, comparing the average figures to the minimum inputs and output figures reveals that some of the district hospitals are more endowed with inputs (in terms of human resource and capital-proxied by the number of beds) than others.

Analysis of DEA results

It is important to recall that DEA identifies the input-output combination and presents it with the "best practice frontier" or data envelope. The DMUs that make up the frontier are assigned a score

of one (1) (or 100%), are technically efficient and becomes peers to the inefficient ones. All the other DMUs not on the frontier are assigned a score between zero and one (or 0% to <100%), and are technically inefficient. Table 2 summarizes the results obtained from DEA models. It shows the average efficiency scores and the standard deviation. These determine the level of efficiency and their distribution in District Hospitals in Ghana.

The results of CRS DEA model indicate that technical inefficiencies exist in the district hospitals in Ghana. The overall technical efficiency scores show that only 13 (25.5%) of the district hospitals are efficient. The remaining 38 (74.5%) hospitals were found to be technically inefficient. The results also show an average technical efficiency score of 77.6%. This means that on the average the district hospitals use 22.4% more inputs than necessary if all of them were to operate efficiently. Overall technical efficiency ranges from 33.1% to 100%. The DEA approach enables the change to Variable Returns to Scale (VRS). This is a relaxation of the assumption that inputs normally will move in exact proportions to the scale of operations. This allows for the existence of increasing and decreasing returns to scale. The DEA under VRS allows for further decomposition of the overall efficiency score into one due to pure technical efficiency (column 3) and one due to scale efficiencies(SE) (column 4). That is TE = SE*pure TE. The implication is that if the overall efficiency is less than one, then this could be attributed to either pure TE score being less than one or the Scale Efficiency being less than one. The VRS DEA results show that 21 (41.2%) of the district hospitals are technically efficient. The average technical efficiency score was found to be 84.52% ranging from 33.5% to 100%. Thus the district hospitals, under the assumption of constant returns to scale, waste an average of 15.48% of their inputs.

Table 2: Summary of Efficiency Scores of District Hospitals

	Overall Technical Score (CRS)	Pure Technical Efficiency Score (VRS)	Scale Efficiency (CRS/VRS)
Mean	0.7764	0.8452	0.9209
SD	0.1811	0.1684	0.1118
Min	0.331	0.335	0.62
Max	1	1	1
Hospitals on Frontier	13	21	14

Source: Author's estimation from Ghana Health Service Data

Most of the district hospitals were found not operating at the optimal scale. The results show that only 14 (27.5%) of the district hospitals are scale efficient. The average scale efficiency is 92.1% ranging from 62% to 100%. This shows that scale inefficiency is one of the factors that reduce overall technical efficiency in the health care industry. For instance, one of the hospitals got a pure technical efficiency of 100% but its overall technical efficiency score is 62%, due to low scale efficiency score of 62%.

Table 3: Returns to Scale

	Increasing Returns to Scale (IRS)	Constant Returns to Scale (CRS)	Decreasing Returns to Scale (DRS)
Number of Hospitals	20	14	17
% Number of Hospitals	39.2%	27.5%	33.3%

Source: Author's estimation from Ghana Health Service Data

From Table 3, 20 (39.2%) of the hospitals exhibit Increasing Returns to Scale (IRS), 14 (27.5%) exhibit Constant Returns to Scale (CRS) and 17 (33.3%) also exhibit Decreasing Returns to Scale (DRS). In order to be efficient, a hospital exhibiting IRS should expand both inputs and outputs, while hospitals exhibiting DRS need to reduce both inputs and outputs.

Discussion of Results

In general, public district hospitals in Ghana are technically inefficient, and since they dominate the public health sector it can be inferred amidst caveat that public health sector in Ghana is technically inefficient. However, it presents some acceptable degree of technical efficiency when compared to the efficiency scores of other African countries. On the average Ghana has a pure technical efficiency of 77.6%. This figure is higher than Kenyan hospitals which scored 70.42% (Owino and Korrir, 1997) but smaller than Botswanaian, Zimbabwean and South African hospitals that scored 83.7% (Tibesigwa, B., 2002), 89% (Nuwbrander, 1993), and 90.6% (Kirigia, 2000) respectively. A direct comparison of Ghana's results with those of other countries is somehow inappropriate since those studies have used different outputs and inputs. Furthermore, the efficiency scores are time specific and they change over time making the results valid only at the point in time when the study was done. However, these results are in conformity with the expectations of this study. The Ghanaian Hospitals' efficiency score might have been influenced by the lack of resources which characterize the health sector.

The introduction of the health insurance and the possible increase in healthcare demand will put more pressure on the available health facilities and the government to increase its health expenditure. Nevertheless, there is some scope for efficiency improvement. About 74.5% of the hospitals were found to be technically inefficient; this means that they have a technical efficiency score of less than one (1). Figure 1 shows a bar graph of the range of overall technical efficiency of the inefficient hospitals.

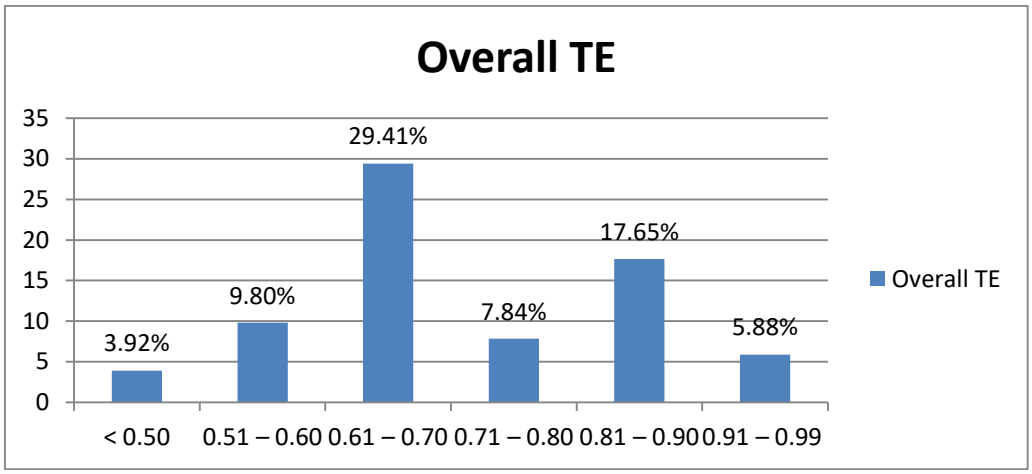

Figure 1: Range of Overall Technical Efficiency (TE) of Inefficient Hospital

Figure 1 indicates that 3.92% of the inefficient hospitals have scores below technical efficiency of <0.50, while 9.80% of them have TE scores between 0.51 and 60, 29.41% of them (representing the majority) have TE scores between of 0.61 and 0.70. In addition, 7.84% of them have TE scores between 0.71 and 0.80, about 17.65% of them have TE scores between 0.81 and 0.90, and the remaining 5.88% of them are between TE score of 0.91 and 0.99. In general, this means that these inefficient groups should be able to reduce the use of all inputs by 75%, 45%, 35%, 25%, and 15% respectively without compromising output levels.

Table 4.4 and Table 4.5 show the descriptive statistics of efficient and inefficient hospitals, respectively. It is evidenced that the inefficient hospitals consume more resources than the efficient hospitals. For instance, the efficient hospitals use a minimum of 1 Medical and Pharmacy Staff, 14 General Administrative Staff, 4 Nursing administration, and 11 beds to produce an average of 4048.15 Total Admissions, 11642.92 Inpatient Days and 47212.38 Outpatient Visits.

Table 4.4: Descriptive Statistics of Efficient Hospital (TE=1.00, n=13)

Variables	Mean	Median	Standard Deviation	Minimum Value	Maximum Value
Outputs					
Total Admissions	4048.15	4013	1604.86	1145	6270
Inpatient Days	11462.92	12473	6035.59	1424	21406
Outpatient Visits	47212.38	37079	30897.03	16226	112207
Inputs					
Medical & Pharmacy Staff	4.00	3	4.75	1	16

Variables	Mean	Median	Standard Deviation	Minimum Value	Maximum Value
General Admissions Staff	51.00	47	30.79	14	122
Nursing Staff	33.00	31	32.27	4	124
Beds	54.85	59	23.93	11	92

Source: Author's estimation from Ghana Health Service Data

Table 4.5: Descriptive Statistics of Inefficient Hospital (TE< 1.00, n=38)

Variables	Mean	Median	Standard Deviation	Minimum Value	Maximum Value
Output					
Total Admissions	4246.90	3690.5	2369.044	1601	12637
Inpatient Days	15522.08	13503.5	10624.85	4723	60576
Outpatient Visits	33491.68	30466.5	26911.83	4395	162254
Inputs					
Medical & Pharmacy Staff	9	6	9.55	1	44
General Admissions Staff	64	58	30.82	25	149
Nursing Staff	51	46	48.09	8	304
Beds	99	105	50.79	30	287

Source: Author's estimation from Ghana Health Service Data

The inefficient hospital, on the contrary, use a minimum of 1 Medical and Pharmacy Staff, 25 General Administrative Staff, 8 Nursing Staff and 30 Beds to produce an average of 4246.9 Total Admissions, 15522.7 Inpatient Days, and 33491.7 Outpatient Visits. Furthermore, the efficient hospitals use a maximum of 16 Medical and Pharmacy Staff, 122 General Administrative Staff, 124 Nursing Staff, 92 Beds to produce a maximum output of 6270 total admission, 21406 inpatient days, and 112207 outpatient days. The inefficient hospitals, on the other hand, use a maximum 44 Medical and Pharmacy Staff, 149 General Administration, 304 Nursing Staff and 287 Beds to produce a maximum output of 12637 Total Admission, 60576 inpatient days, and 162254 outpatient days.

As indicated earlier, these inefficient hospitals need to reduce inputs in order to become efficient. There are two methods of calculating input reductions needed in individual hospitals:

1) By the use of Efficiency Reference Set (ERS) or

2) Using Input Slacks

This study applied the use of Input Slacks to calculate the input reduction needed in the various inefficient hospitals. The results are presented in Table 4.7

Table 4.7: Inputs Reduction needed to make Inefficient Hospitals Efficient

Hospital Code	Excessive Inputs Usage By the Inefficient Hospitals			
	Medical &Pharmacy	General Administration	Nursing Administration	No. of Beds
1	1.469	9.867	4.719	9.581
2	0.507	4.225	9.921	8.45
5	0.717	7.409	3.824	15.57
7	8.604	9.064	5.253	14.122
8	3.28	25.912	33.909	37.064
9	7.45	23.472	25.428	39.12
11	0.496	14.632	26.069	39.131
13	3.159	18.603	20.032	45.63
15	1.903	3.705	3.445	4.03
17	0.402	8.241	4.422	54.474
19	1.146	19.482	12.606	40.874
20	5.041	18.3	11.224	26.84
21	0.784	9.31	11.854	43.295
22	1.244	7.775	24.202	13.684
23	0.845	4.394	7.235	10.478
25	2.846	7.776	14.191	18.954
26	2.982	29.175	17.175	40.067
27	8.291	36.869	25.675	59.645
28	3	34.719	20.247	27.873
30	2.88	29.76	17.872	38.08
32	5.448	26.013	14.326	32.422
35	0.321	16.412	0.008	0.03
36	13.805	99.085	42.56	102.41
37	0.28	6.58	64.05	5.46
42	1.204	9.331	12.379	13.545
43	4.105	12.768	6.389	17.29
45	6.157	6.272	4.508	15.387
49	11.085	5.98	6.095	16.1
50	1.375	9.425	5.525	22.1
51	1.512	15.498	6.804	19.656

Source: Author's estimation from Ghana Health Service Data

CONCLUSION AND POLICY IMPLICATIONS

This study employed Data Envelopment Analysis (DEA) approach to assessed whether the public district hospitals are technically efficient to meet the challenge of possible increase in health care demand by Ghanaians that might result from the implementation of the National Health Insurance Scheme. It aimed at providing policy makers additional information to ensure efficiency resource utilization in implementing the national health insurance scheme. The DEA results show an average overall TE of 77.6%, pure TE of 84.5% and scale efficiency of 92.1%. This finding lends support to the commonly held view that public sector hospitals in developing countries are inefficient.

Out of the 51 public district hospitals used in the study, 30 of them were purely Technically Inefficient while the remaining 21 were purely Technically Efficient. The results also indicate that in general, a total of 102 Medical and Pharmacy Staff, 530 General Administrative Staff, 462 Nursing Administration and 830 beds are wasted by the public district hospitals. In relation to the excess resources, there are a number of policy options available to health managers. Health managers can reallocate these excess inputs to underserved areas or understaffed health units. This would increase accessibility to health services and the quality of services provided. However, the policy is effective only if the cost of reallocation does not exceed the cost of maintaining the resources in its original location. The managers could choose to sell the excess number of beds and the space they occupy to private health practitioners if there is demand. This could be used as a means to raise revenue for that particular health unit and for the health sector in general. This policy action, however, requires managerial independence for deciding which bed or space to sell (rent). The fact that 20 (39.2%) of the public district hospitals exhibit IRS and 17 (33.3%) of them show DRS justify the downsizing by those exhibiting DRS and the reallocation of these resources to those showing IRS.

The results indicate the potential to improve access and/quality of care without injecting additional resources into the health sector. This is important given the financial constraints on the social sector investment in Ghana. The study has assessed and made specific policy recommendations on each of the 51 public district hospitals that were involved in the study to ensure efficient utilization of resources in implementing the national health insurance scheme.
The management of those hospitals should strengthen their operations to be in position to meet increase in demand for health care due to the implementation of the Health Insurance Scheme. It will be desirable to replicate this study in other hospitals so as to assess the gravity of the problem and its causes, in order to maximize possible efficiency savings. Any policy to inject additional resources into the health sector should be justified on other grounds.

REFERENCES

Banker, R. D., Charness, A. & Cooper, W. W., (1984). Some Models for Estimating Technical and Scale Inefficiencies in Data Envelopment Analysis, *Management Science*, 30(1),1078 – 1092.

Barnum, H. & Kutzin, J., (1993). Public Hospital in Developing Countries: Resource Use, Cost, Financing. Baltimore: John Hopkins University Press for the Word Bank. Chapter 3.

Bitran, R., (1989). Household Demand for Medical Care in Santo Domingo. Health Care Financing in Latin America and the Caribbean Research Report No. 9.

Bjurek H., Hjalmarsson L. & Forsund F., (1990). Deterministic parametric and non-parametric estimation of efficiency in service production: A Compariso,. *Journal of Econometrics*, 46(1/2), 213-227.

Bowlin W., (1999). Measuring Performance; An Introduction to Data Envelopment Analysis (DEA). Department of Accounting, University of Northern Iowa, Cedr falls, 50614-0127.

Charness R. F., Cooper W. W. & Rhodes E., (1978). Measuring the Efficiency of Decision Making Units, *European Journal of Operational Research*, 2, 429 – 444.

Coelli, T., Rao, D. S. P. & Batteses G., (1998). An Introduction to Efficiency and Productivity Analysis. Boston: Kluwer Academic Publishers, 275p.

Evans, D., Tandon, A., Murray, C. & Laner, J., (2000). Measuring Overall Health System Performance for 191 Countries. *Discussion Paper No. 30*, World Health Organization.

Eyob, Z., (2000). Hospital Efficiency in Sub-Saharan Africa: Evidence from South Africa. World institute of Development Economic Research, 39p.

Ferrier, G. D. & Valdmanis, V., (1996). Rural Hospital performance and its correlation, *Journal of Productive Analysis*, 7, 63-80.

Folland, S. & Hofler, R., (1995). On the Technical and Allocative Efficiency of United States Hospitals: A Stochastic Frontier Approach. Oakland University, Michigan, 40p.

Ghana Health Service: Annual Report, (2000). Reproductive and Child Health Unit, Ghana.

Ghana Health Service, (2006). Fact and Figures. Policy, Planning, Monitoring and Evaluation Division, Ghana.

Greene, W. H. (1993). Econometric Analysis (2nd edition). New York: Macmillan.

Jehu-Appiah, C. , Sekidde S., Adjuik, M. , James Akazili J., Almeida S. D. 4, Nyonator F. , Rob Baltussen, R., Asbu E. Z. and Kirigia, J. M. (2014). Ownership and technical efficiency of hospitals: evidence from Ghana using data envelopment analysis, *Cost Effectiveness and Resource*, 12(9), 1-13.

Kirigia, M. J., Lambo, E. & Sambo, L., (2000). Are Public Hospitals in Kwazulu –Natal Province of South Africa Technically Efficient? World Health Organization Regional Office for Africa, 25-32.

Lovell, C. A. K., (1993). Production frontier and productive efficiency, in Fried H. O., C. A. K. Lovell and S. S. Schmidt (eds), The measurement of Productive Efficiency: Techniques and Applications. New York: oxford University Press, 3-67.

Osei, D., d'Almeida, Melvill, O, Kirigia, J, Ayiya, O. & Kainyu H., (2005). Technical efficiency of public district hospitals and health centers in Ghana: A Pilot Study, 13p.

Quaye, R., (1991). Planning the Health Care System in a Decade of Economic Decline: The Ghanaian Experience. *Crime, Law, and Social Change*, 16 (3), 303-311.

Shearman H., (1984). Hospital Efficiency Measurement and Evaluation: Empirical Test of a New Technique. Medical care, Volume 22 No. 10

Tibesigwa, B., (2002). Evaluating Technical Efficiency of General and Primary Hospitals: The case of Botswana, University of Botswana (Unpublished).