

WHAT ARE THE TECHNICAL AND ALLOCATIVE EFFICIENCIES OF PUBLIC HEALTH CENTRES IN GHANA?

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SUMMARY

Introduction: Health systems in developing countries including Ghana are faced with critical resource constraints in pursuing the goal of improving the health status of the population. The constrained ability to adequately meet health care needs is exacerbated by inefficiency in the health care systems, especially within public health centres.

Methods: The study used Data Envelopment Analysis (DEA) method, to calculate the technical and allocative efficiency of 113 randomly sampled health centres. A logistic regression model was also applied on whether a health centre was technically efficient or not to determine the factors that significantly influence the efficiency of health centres.

Findings: The findings showed that 78% of health centres were technically inefficient and so were using resources that they did not actually need. Eight-eight percent were also allocatively inefficient. The overall efficiency, (product of the technical and allocative efficiency), was also calculated and over 90% of the health centres were inefficient. The results of a logistic regression analysis show that newer health centres and those which receive incentives were more likely to be technically efficient compared to older health centres and those who did receive incentives.

Conclusion: The results broadly point to grave inefficiency in the health care delivery system of the health centres and that lots of resources could be saved if measures were put in place to curb the waste. Incentives to health centres were found to be major motivating factors to the promotion of efficiency.

Keywords: Technical efficiency, Allocative efficiency, Resource allocation, Health Centres, Ghana

INTRODUCTION

A recent critical review of the Health Sector Reforms in Sub-Saharan Africa points to the fact that besides the issue of ever diminishing financial inflows to the health

sector, poor quality of health care; mainly occasioned by a variety of inefficiencies at all levels of health care delivery, is one of the most important concerns of the sector.¹ This has led to a number of reform initiatives and strategies in nearly all developing countries.^{2,3}

Health centres are important as far as health resources are concerned because they demand a relatively large proportion of the health sector's financial, human and capital resources, yet most of them perform far below expectation thus raising doubts on their efficiency.⁴ The on-going health sector reform initiative in most developing countries places tremendous interest and importance on health centres as the first contact with the formal health care system. Hence health centres are faced with the "efficiency challenge" of reaching the efficiency levels expected of them; essentially to solve 80% or more of health care needs of the population.⁵ There are two basic measures of efficiency: allocative and technical efficiency. Allocative efficiency (an economic concept) refers to how different resource inputs are combined to produce a mix of different outputs. Technical efficiency on the other hand is concerned with achieving maximum outputs with the least cost. Overall efficiency measures the combined effect of allocative and technical efficiency.³

To enhance the effectiveness and efficiency of health centres, planners need to develop methods to tackle the problems of accessibility, acceptability, intensity of use and compliance with medical instructions, quality of care, recurrent costs, and community ownership.⁶ To develop these methods, planners need prior knowledge of the efficiency levels in the health centres. Unfortunately, there is limited literature on efficiency measures of health centres.

Health systems in developing countries including Ghana are faced with critical resource constraints in pursuing the goal of improving the health status of the population.

While health care resources are shrinking, health care needs are growing as a result of multiple factors including emerging and re-emerging health problems. The constrained ability to adequately meet health care needs is exacerbated by the perceived extensive inefficiency in the health care systems, especially within the health centres.

In Ghana, the health centres¹ consume substantial amount of the district allocation of both financial and human resources.⁷ This is due to the policy to decongest the referral centres and make the first contact more effective.⁵ In addition there are also efforts following the government's endorsement of the primary health care concept to equip the health centres to provide simple but effective health care to the community. They are also to serve as effective referral points to the Community based Health Planning and Service (CHPS)² delivery. The purpose of the paper is to measure how efficient the health centres in the country operate and evaluate factors that could explain the efficiency or inefficiency of health centres in Ghana. A health centre until the introduction of CHPS (see footnote below) was the first level of contact with the formal health sector in Ghana.

Unlike hospital studies^{8, 9, 10}, there have been a few efficiency studies on health centres² and only one pilot study in Ghana¹¹. As Primary Health Care (PHC) services gain more attention, it is not surprising that the World Health Assembly through its resolution *WHA44.27* is urging WHO to promote health centres quality, effectiveness, coverage and efficiency studies through "awareness of the impending urban health crisis".⁵

The pilot study in Ghana was conducted in 2002 on the technical efficiency of 21 public health centres and 21 hospitals¹¹ and the results show that only 18 % of the health centres were technically inefficient. According to the paper, the sample of the health centres was too small (about 4% of public health centres) and that the results could not be generalised for the whole country and so the study suggested further comprehensive studies on the technical and allocative efficiency of health centres. The current study samples about 20% of the public health centres in Ghana and is not only carrying

technical efficiency but allocative and the combined effect of the two types of efficiencies.

METHODS

The Health Sector of Ghana

After 50 years of Ghana's independence, the health status of the country is that of a developing country at the onset of a health transition with predominance of communicable disease conditions, malnutrition, high infant mortality and generally poor reproductive health with emerging importance of non-communicable diseases. The health sector is organised along a five-tier system (national, regional, district, sub-district and community levels) to serve the country population of 19.7 million.¹² The reorganisation of the health sector is part of reforms being undertaken to improve efficiency among others in the health system. Other aspects of the reforms include decentralised planning and budgeting system, strengthening of financial management and performance monitoring system. The sub-district sectors which are the health centres serve as referral point for the community clinics. In places where there are no community clinics, health centres are the first contact point of modern health care to the people. Despite the strategically dispersed health centres in the country, the teaching, regional and district hospitals still have to contend with high outpatient and other primary health related cases.⁷

Data collection

A structured form for secondary data and a questionnaire were used for the data collection. The structured form was used to collect inputs and output data. Input data included the number of staff, beds/cots, supplies and recurrent expenditure. The output data included number of outpatients, antenatal care, deliveries, children immunized, and family planning update. These inputs and outputs were used to estimate the technical and allocative efficiencies. A structured questionnaire was used to collect information on factors that were likely to influence the efficiency and productivity of the health centres. Data on inputs and outputs was collected for the financial year 2003/2004. The instruments were pre-tested in the Kassena Nankana district, Upper East Region for consistency and accuracy before actual data collection.

Three data collectors (graduate level) were recruited and trained for two weeks in May 2005. Each of the data collectors was assigned to work in the three areas - north, middle and coastal belts of Ghana to collect data. Data collection was preceded by a certification from the Ethical Review Committee of the Ghana Health Service. Consent was sought at each health facility before data collection.

1 A health centre services a geographical area with 15 000 to 30 000 population. It provides basic curative care, disease prevention services and maternity services⁷

2 CHPS is a strategy for the health care delivery system to provide cost-effective and adequate quality basic primary health services to individuals and households in the communities where they live through engaging the community in the planning and delivery of services⁷

Supervision was conducted by the Principal Investigator to ensure that data were properly collected.

Sampling and sample size calculation

According to Ministry of Health 1999 report, there were 550 health centres¹³ in the country and using an expected efficiency rate of health centres to be 20%, a precision of 7% at the 95% confidence level we calculated the required sample size as 103. Since this was a nation-wide survey, we expected about 30% missing/non-response in the collection of the data and so the expected sample size came to 147 health centres. To ensure a fair distribution of eligible health centres across the country we stratified the regions by ecological belt; (Upper East, Upper West, and Northern) as the northern belt, (Ashanti, Brong Ahafo, Eastern, Volta) as the middle belt and (Greater Accra, Central, Western) as the coastal belt. Thus weighting by the number of districts within a belt, we obtained the expected number of health centres to be interviewed by belt as 32 for the northern belt, 78 for the middle and 37 for the coastal. This was based on an average of about 5 health centres per district.

We used a multi-stage sampling design whereby in the first stage of sampling, two regions each were randomly selected from each of the belts. Thus Upper East and Upper West were sampled from the northern belt, Ashanti and Volta from the middle belt and Western and Greater Accra from the coastal belt. In the second stage we sampled districts within the regions. We decided to visit all health centres in every district that was selected within a region. In the Upper East and Upper West regions we selected all the districts (11) in order to make up the sample size requirement by ecological belt. In the middle belt twelve districts were randomly selected from Ashanti and three from Volta and in the coastal belt six districts were selected from Western region and three from Greater Accra.

Data analysis

Two stages of data analysis were carried out in this study. In the first stage, data collected were entered using Epi Info™ 3.3, and the technical and allocative efficiency scores were computed using Data Envelopment Analysis programme, version 2.1 (DEAP 2.1).^{14, 15}

Calculations of productivity efficiency scores were made by solving the following fractional linear programming problem:

$$Max h_0 = \frac{\sum_{r=1}^s u_r y_{rj_0}}{\sum_{i=1}^m v_i y_{ij_0}} \dots\dots\dots(1)$$

Subject to

$$Max h_0 = \frac{\sum_{r=1}^s u_r y_{rj_0}}{\sum_{i=1}^m v_i x_{ij_0}} \leq 1 \quad ; j = 1, \dots, j_0, \dots, n$$

$$u_r \geq 0, r = 1, \dots, s \quad \text{and} \quad v_i \geq 0, i = 1, \dots, m$$

Optimization is performed separately for each unit to compute an optimal set of weights ((u_r, v_r) and efficiency measure h_0 . The terms y_{rj_0} and x_{rj_0} represent the amount of output r and the amount of input i for the unit j_0 . The method chooses values of u_r and v_r which are most favorable to the unit that is being studied. As a consequence, a unit that is superior to all others on any single output-input ratio will be rated efficient.^{16, 17, 18, 19}

The standard DEA model, the relative efficiency of production unit is defined as the ratio of the sum of its weighted outputs to the sum of its weighted inputs. The weights have been determined so as to show the production unit at the maximum relative efficiency. The model in (1) is a fractional programming model, which can be converted into a linear form so that the methods of linear programming can be applied.^{17, 20}

In the study we adopted the input oriented-based approach and also assumed constant returns to scale. Health centres or Decision Making Units have better control over inputs than outputs hence our interest in the input-based approach. This approach is also more popular in terms of usage than the output oriented approach²⁰, and hence our linear model was given as:

$$Max h_0 = \sum_{r=1}^s u_r y_{rj} \dots\dots\dots(2)$$

$$\text{Subject to} \quad \sum_{i=1}^m v_i x_{ij}$$

$$\sum u_r y_{rj} - \sum v_i x_{ij} \leq 0 \quad j = 1, \dots, n$$

$$u_r, v_i \geq 0$$

The variables of the above problem are the weights and the solution produces the weights most favorable to the unit j_0 , and also produces a measure of efficiency. The first stage is thus to obtain efficiency scores for each health centre. The efficiency scores will give an indication of the health centre performance at a given point in time. The health centre with a high value of h_0 in comparison with all others on any single output-input ratio would be taken to be efficient relative to the others. The efficiency scores would indicate the facility performance at a given point in time. Using the above input and output sets we model the health centre services as a multi-input and multi-output production process.

In the second stage, the study applied logistic regression to find out how various economic, structural and demographic factors affect the DEA efficiency measure. The dependent variable, $\text{logit}(p_i)$ was regressed against possible explanatory variables where p_i is the success probability corresponding to the i th technically efficient health centre. For the observations on n health centres the random variable Y_i (Health centre is technically efficient) is from a binomial (n, p_i) distribution and Y_i are independent: Log odds ($Y_i=1$) can be expressed as:

$$\text{Log odds } (Y_i=1) = \text{logit } (p_i) = \log\left(\frac{p_i}{1-p_i}\right) = b_0 + b_j X_{ij} \quad i = 1, \dots, n \quad j = 1, \dots, k$$

Where the X_{ij} represents the j th independent variable at health centre i , and the b_j are the parameter estimates of the model. Technical efficiency was used in the regression analysis because it seeks to unearth the waste in resource use in the production system of the health centres and how cost could be minimised. Key variables (see Table 1) were identified and used to regress the technically efficient scores where 1=technically efficient (100% score) and 0=technically inefficient (<100%). A *p-value* of 0.05 or less was considered significant.

RESULTS

Out of a total population of 550 health centres in the country, data was collected from 139 health centres but 113 health centres were included in the analysis be-

cause they had complete data. The results are presented in two sections: results of the DEA analysis and the Regression results.

Data Envelopment Analysis of Efficiency

The technical efficiency score ranges between 21% (0.21) and 100% (1.00) and the allocative and overall efficiency score ranges between 11% (0.11) and 100% (1.00). The lowest performing health centre is only performing about 21% and the highest is 100% in terms of the technical efficiency. With regards to the allocative and overall efficiencies, the lowest performing health centre is performing at 11%.

Figure 1: Summary of technical, allocative and overall efficiencies of public health centres in Ghana

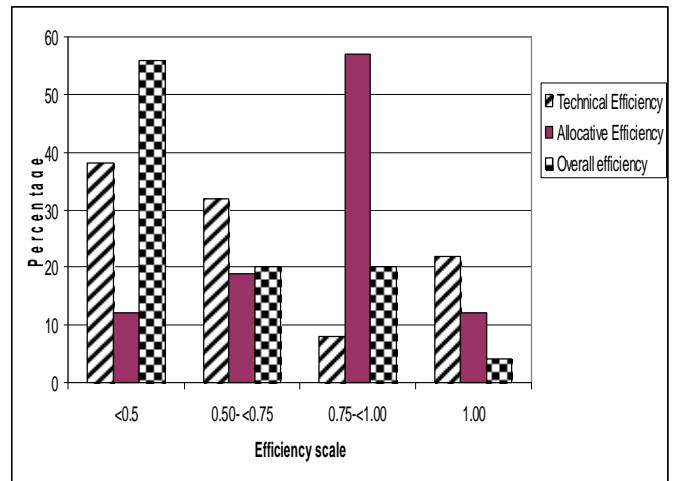


Figure 1 summarises the efficiency scores of the sample health centres. The results show that 22% of the sampled health centres are technically efficiency; with efficiency scores = 1 or 100% relative to the rest of the health centres. Eight percent of the health centres had technical efficiency score between 0.75 and 1.00, 32% of the health centres had technical efficiency between 0.5 and less than 0.75 and 38% had technical efficiency scores of less than 0.5.

With regard to allocative efficiency, only 14 health centres (12%) were found to be efficient (efficiency score=1). However, unlike technical inefficiency, more than 50% of health centres had allocative efficiency score in the range of 0.75- < 1.00 (Figure 1).

The overall efficiency, which is the product of the technical efficiency, and allocative efficiency was also calculated, only 4% of the health centres were both technically and allocatively efficient with over 50% of them having efficiency scores less than 0.5 (Figure 1).

Regression Analysis of Efficiency

Results in Table 1 show that 80 and 69% of the technically efficient health centres have their clinical and non-clinical staff respectively receiving incentives from DHMT compared to about 47% and 42% of the technically inefficient health centres. Also a higher percentage of the technically efficient health centres (80%) have safe drinking water than the technically inefficient health centres (72%).

Table 1: Descriptive statistics of variables use for the logistic regression

Variable	Technically inefficient	Technically efficient
	n/N (%)	n/N (%)
DHMT responds to needs of HC	73/88 (83.0)	17/25 (68.0)
HC has means of transport	63/88 (71.6)	16/25 (64.0)
HC has problems when transport is not available	81/88 (92.1)	21/25 (84.0)
HC's infrastructure is good	37/88 (42.1)	8/25 (32.0)
HC has access to safe drinking water	63/88 (71.6)	20/25 (80.0)
Source of light is electric	60/88 (68.2)	14/25 (56.0)
HC has a health committee	40/88 (45.5)	15/25 (60.0)
Proportion of revenue retained by HC	67/88 (76.1)	20/25 (80.0)
Clinical staff receive incentives from DHMT	41/88 (46.6)	20/25 (80.0)
Non-clinical staff receive incentives from DHMT	37/88 (42.1)	15/25 (69.0)

Logistic Regression Analysis of Influential factors

Logistic regression of technically efficient health centres (teff = 1) on the variables in Table 1 of covariates. A backward stepwise regression analysis with variables excluded from the model when $p > 0.1$ was carried out. Table 3 show the variables retained in the final model, which shows that the age of the Health Centre (HC), the response of the DHMT to the needs of the health centre and the incentives received from the District Health Management Team (DHMT) are the key factors likely to affect how technically efficient a health centre could be. Health centres which have been in existence for at most 13 years were over 3 times more likely to be technically efficient than older health centres, Odds Ratio (OR) (3.53; 95% CI: 1.22 - 10.2, $p=0.02$). Health centres which received incentives from the

DHMT were over 9 times more likely to be technically efficient than health centres which did not, OR (9.36; 95% CI: 2.16 - 40.5, $p=0.003$). However health centres which stated that the DHMT responded to their needs were 86 % less likely to be technically efficient than health centres which did not, OR (0.14; 95% CI: 0.03 - 0.60, $p=0.009$).

DISCUSSION

Public health centres support the CHPS and provide preventive, affordable, promotive, and basic curative care in rural localities inhabited mainly by the poor. Their location makes them critically important in the ongoing efforts to scale up pro-poor cost-effective public health interventions geared at achieving the health-related Millennium Development Goals²¹ and New Partnership for Africa's Development (NEPAD) health targets²². Thus, the importance of these close-to-client health facilities in all efforts to reduce the burden of disease and improve health conditions, especially in rural areas, cannot be overemphasised.

On the whole, the primary source of inefficiency was technical (under-utilisation of resources in the delivery of health services). The results of the 113 public health centres sampled show that 78% of them were technically inefficient. This finding compares favourably with other studies especially in Sub-Saharan Africa. A study of 155 primary health care clinics in Kwazulu-Natal province in South Africa found 70% of them to be technically inefficient.²³ A similar study of 32 public health centres in Kenya revealed that 56% of them were technically inefficient.² This lower figure in the technical efficiency in Kenya could be due to the small sample.

On average, health centres are using more inputs than needed at current operational level and should aim at minimising cost. The operations and performance of health centres could be strengthened if resources are better utilised, the savings (either in terms of deficit reduction or the less probable actual cost reduction) generated from improved efficiency could be channelled to other areas of need within the health care system. The geographic inequity in health care services is also revealed in this study such that the middle belt of Ghana has a higher percentage of inefficient health centres than the two other belts (northern and coastal).

In the allocative sense, the results show that many health centres are employing 'wrong' or inappropriate inputs. The problem of allocative inefficiency touches on management.

In particular, the results of this study points to the fact that health centre's managers should scan through the whole production process to ensure that not too much of inputs or wrong combination of inputs are used.

The logistic regression results showed that the more recently established the health centre, the more likely it would be efficient and this may be due to the fact that more attention is often directed to the health centres that are starting or which are newer. It was also oddly revealed that health centres, which stated that DHMT responded to their needs, were 86% less likely to be efficient than those whose needs were not met by the DHMT. Reflecting on the data collection process, the data collectors were often accompanied by a member of a DHMT to the health centres and even though the interview is often very private and the respondents (in-charges of the health centres) were often told that data collected was going to be treated with strict confidentiality, some of the heads of the health centres might have been apprehensive if their bosses at the DHMT get to know the responses to this sensitive question. It may also be possible that the finding is not odd but that the responses to their needs may not be directly related to the production process of health centres and so it would not affect the technical efficiency status of the health centres.

The most exciting findings is the effect of incentives to clinical staff on the technical efficiency of health centres, indeed the importance of incentives to the technical efficiency came out strongly. This finding is supported by a study in Guinea Bissau which found out that financial incentives significantly influence performance of health workers.)³ Health centres whose clinical staff got incentives were more than 9 times more likely to be technically efficient than health centres that were not given incentives. Showing appreciation through various forms of incentive packages from the DHMTs to the health centres could go a long way to improve on the performance of health centres

CONCLUSION

In conclusion, the study revealed that 78% health centres are technically inefficient and so are using unnecessary resources. This means they could lower their cost by 48% and still achieve their current levels of output. This could result in better services delivery. With regard to allocative efficiency, only 12% were allocatively efficient. The overall efficiency, which is the product of the technical efficiency and allocative efficiency, was also calculated and over 90% of the health centres were inefficient. A logistic regression

analysis shows that the age of the health centre, the response of the District Health Management Team (DHMT) to the needs of the health centre and the incentives received from the DHMT are the key factors likely to affect how technically efficient a health centre was. Based on the findings of the study, we recommend that a critical look should be made to all the health centres that are inefficient and more particularly the health centres that have efficiency score below 50% and if feasible reallocate resources rationally. Also efficiency assessment could be factored into the regular monitoring of health facilities in the public health sector.

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