Technical Efficiency of District Hospitals in Afghanistan: a Data Envelopment Analysis Approach

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Abstract

The objectives of this study were to measure the Technical Efficiency (TE) of District Hospitals (DHs) and to determine factors affecting the hospitals' efficiency. Input-orientated Data Envelopment Analysis (DEA) was applied to measure the technical and scale efficiency scores of 68 DHs in the Solar years of 1389 and 1390. At the second stage of this study, a Tobit regression analysis model was used to assess the influential determinants of the hospitals' efficiency. Results of the DEA indicated that 40 (59%) and 38 (56%) of the DHs were inefficient in 1389 and 1390 respectively. Mean of Variable Return to Scale (VRS) TE was 90% and 88% during the two periods of the study, respectively. The Increasing Return to Scale (IRS) of DHs was 51 (75%) and 52 (76%) for their patterns of scale inefficiency for the years 1389 and 1390, respectively. Total number of slack inputs, such as, doctors, nurses, midwives, non-medical staff and beds were (46.30, 19.57, 20.51, 10.46, 97.87) in 1389 and (29.97, 11.06, 12.28, 11.45, 70.50) in 1390. Average Length of Stay (ALOS), Bed Occupancy Rate (BOR), OPDPHY (Outpatient-Physician ratio) and (BEDPHY) Bed-Physician ratios have been regressed against VRSTE scores. Results of the Tobit regression model revealed that outpatient-physician ratio was significantly correlated to VRSTE at 95% Confidence Interval (CI) in the solar years of 1389 and 1390, while ALOS, BOR and BEDPHY were found insignificant during both periods of the study. However, their signs were similar to

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what was expected. Exclusion or omitted variables in the model might be possible reasons for insignificancy in the regression model.

Key Word: Data Envelopment Analysis, District Hospitals, Hospital Efficiency, Technical

Introduction

Decades of conflict and political uncertainty in Afghanistan have almost ruined all sectors of the country, and Afghanistan's health sector has widely suffered from unstable situation of the country. Access to basic healthcare services and hospital services were inconceivably limited. After establishment of the transitional government in 2001 in Afghanistan, The Ministry of Public Health (MoPH) of Afghanistan decided to increase equitable distribution of healthcare services throughout the country. Therefore, MoPH introduced a comprehensive strategic package; Basic Package of Health Services (BPHS). The main purpose of (BPHS) is to provide a standardized package for delivering basic health care services. Fortunately, introduction of this package has increased coverage and accessibility in a considerable scale. Later on in 2005, another package was introduced as complementary to BPHS and it was Essential Package of Hospital Services (EPHS). In a general sense, BPHS provide primary healthcare services throughout the country while EPHS cover secondary and tertiary healthcare services. However, they are interrelated through District Hospitals (DH). According to Afghanistan's MoPH, types of facilities used by (BPHS) are consisted of Health Post (HP), Health Sub Center (HSC), Mobile Health Teams (MHT), Basic Health Center (BHC), Comprehensive Health Center (CHC) and District hospitals (DHs). Health facilities in (EPHS) are divided into three levels; Provincial Hospitals (PHs), Regional Hospitals (RH) and National Hospitals (NHs) (MoPH, 2010a). At the district level, the DHs provide all BPHS services, including the most complicated patients and cases. Hospitals are part of the referral system in the health system of Afgha-

nistan. For instance, patients who need macro surgeries under general anesthesia, X-ray services, and comprehensive obstetric care will be referred to DHs from other BPHS facilities. DHs handle comprehensive inpatient and outpatient care. Also, DHs provide a wide range of essential drug, treat malnutrition children. Rehabilitation of patients is also part of the services that are being provided by the DHs. According to the MoPH a DH is supplied by specific number of doctors, nurses/midwives, lab and x-ray technicians, pharmacist, dentist and dental technician and physiotherapists. Each DH covers a population of 10000-300000 (MoPH, 2010a).

Cases which cannot be treated at the district level should be refereed to higher levels of health facilities. The PH provides more advanced services than DHs and covers the provincial population as a whole. Cases that cannot be treated at the PHs are referred to RHs. At the RH level, the hospital provides services that cannot be provided at the PHs and covers provinces located at the respective region. Ideally, there should be a referral system between all different levels of health facilities through which cases can be referred from one level of care provision to the next, where they can receive necessary treatment (MoPH, 2010a).

Even though MoPH has considerable achievements in terms of healthcare services distribution and coverage, challenges and problems are still exist. Afghanistan health system is widely dependent on external donations and aids of international agencies such as United States Agency for International Development (USAID), the World Bank (WB) and European Commission (EC) (MoPH, 2009).

Sustainability of the health system in long run is a major source of concern for the policy makers at the national level. Therefore, attempts are going on to build sustainable healthcare services for the citizens. Limited resources should be wisely used in all levels of healthcare provision. This paper can be a tool for policy makers to make wise decision in terms of wise allocation of resources. For instance, Concerning hospitals with outputs falling short of the DEA targets, MoPH policy makers can improve their efficiency by improveing access to under-utilized health promotion, preventive and out-

patient services, e.g. family planning services, antenatal and post natal care, hospital deliveries, child growth monitoring, immunization, Insecticide Treated Bed Nets, antimalarial treatment for fever (UNICEF, 2003). Alternatively, result of this study may improve efficiency of the DHs through transformation of human resources and capital resources for the health facilities experiencing shortages of resources. Savings of non-salary running costs could be invested in strengthening of primary level health facilities and community health out-reaches (MoPH, 2010b). Also, evidence based facts indicate that inefficiency of healthcare institutions can create problems for equitable delivery of healthcare services. Hence, my study will find Technical Efficiency (TE) of DHs as a proxy for performance of these institutions.

Another question might be asked that why DHs are the only facilities that are being studied in this research. According to the Statistical central office of Afghanistan, 20.6 million of populations out of 26 million live in rural areas of the country where DHs are the ultimate destination for the most of rural residents (MoPH, 2010c). Furthermore, hospital expenditure compose one third of total health expenditure in Afghanistan and therefore special attention should be given to hospitals at the country level.

Objectives and Scope

Objectives

The main objectives of this study are follows:

1. Determine hospitals efficiency with an exclusive focus on technical efficiency of DHs through appraisal of efficiency score and identify determinants of DHs efficiency in Afghanistan

2. Measure and compare technical and scale efficiency of District Hospitals

3. To understand magnitude of inefficiency in inefficient District Hospitals.

4. To identify efficiency determinants for District Hospitals in Afghanistan.

Scope of Study

This study is an analysis of Technical Efficiency of DHs within (BPHS) for the solar calendar of 1389 and 1390 in Afghanistan. Lately mentioned is a comprehensive strategic package that delivers primary healthcare and hospital services at DH level throughout Afghanistan. The data which was used for this study is cross sectional secondary data. Afghanistan's Health Management Information System (HMIS) data base has provided the required data.

Literature Review

Numerous challenges are still present within sustainable health-care financing in different countries. Regardless of being high income, middle income or low income; increasing demand for healthcare services and inflationary cost of services are a major source of concern for the policy makers at the national agenda. Therefore, hospitals and other healthcare provider institutions functionality which compose a large portion of expenditure in the functional classification of total healthcare expenditure have drawn attention of health economists. Exclusive attention to efficient operations is becoming more pro-nounced. Similar to other fields, in healthcare systems, measurement of efficiency is a main and may be the first step in auditing individual performances as unit of production is paramount importance. Consequently, rational distribution of human and capital resources could be used on basis of their efficiency measurements. The term efficiency is widely used in the modern Economics and refers to wise utilization of resources in production of services. Commonly used type of efficiency is TE, referring to the effective use of resources in producing outputs (Moshiri, 2010).

In the Farrell (1957) perception, a hospital is considered to be technically efficient if it operates on the best practice production

frontier in its hospital industry. In the original Farrell framework, the entire observations on a given sample are assumed to have access to same technology (Ozcan and Luke, 1993).

Mangusson (1996) said that measuring TE, allows us to compare hospitals in terms of their real use of inputs and outputs rather than costs or profits.

A hospital is considered to function technically efficient if an increase in an output requires a reduction in at least one other output, or an increase in at least one input. Alternatively, a reduction in any input must require an increase in at least one other input or a decrease in at least one output (Färe, Grosskopf, Lindgren and Roos 1994). On the other hand allocative efficiency or sometimes called cost efficiency occurs when inputs or outputs are combined to their best possible uses in the economy domain so that no further gains or achieve in output or welfare are possible.

To measure hospital's efficiency, the hospital's output(s) must be clearly defined. There are many aspects that can be considered for the measurement of a hospital's outputs such as number of outpatient visit, number of surgical procedures performed, number of patient days, number of lab test given, bed turnover, and average length of stay (ALOS), among others (Moshiri, 2010).

It should be kept in mind that in healthcare service provider institutions, usually output is measured in terms of number of services provided or number of patient days though later mentioned measures are only indicate intermediate outputs. In most cases, effectiveness of interventions and services is concerned (Cleverley, 1992).

A hospital can indicate constant returns to scale (CRS), increasing returns to scale (IRS) or decreasing returns to scale (DRS). Returns to scale stimulate health decision makers what happens if, for instance, they increase all hospital inputs by the same proportion or amount (Grosskopf, 1987). This could result in three different outcomes: (i) CRS-doubling of all inputs results in doubling of outputs; (ii) IRS-doubling of all inputs may lead to more than a doubling of output; and (iii) doubling of all inputs leads to less than doubling of output. The

implications for policy depend on which scenario prevails (Kirigia, 2008).

Various factors can affect hospital efficiency. For instance, charter state of the firm (profit or not profit organizations) determines efficiency (Briker, 1989). Sign of the variable is positively hypothesized if institution is for profit and negatively hypothesized if it is non-profit institution. Meanwhile, other factors such conjunction of nursing home with hospital, reimbursement policy, BOR, ALOS, age of population might have positive or negative impact on efficiency level of hospitals and nursing homes (Briker, 1989).

Beyond to that, other involved studies with hospital efficiency explains quite different factors which have considerable influences on hospital efficiency as a proxy of hospital performances. Wage rate of doctors, teaching facilities, state of ownership; governmental or private, are the mentioned determinants of hospital efficiency (Sear, 2000).

According to another study which is a case study about central government owned hospitals in Taiwan (Chang, 1989) four operating characteristics are identified as determinants of hospital efficiency. Complexity of services, occupancy rate, proportion of veteran, anticipatory impact of National Health Insurance are hypothesized to have negative, positive, negative and positive impacts on hospital efficiency respectively (Shanahan, Ross and Browneli 1999).

Research Method

Study Design

This is a cross-sectional descriptive analysis. Calculation and Analysis of technical efficiency of District Hospitals within BPHS in Afghanistan is the core objective of this study, and determination of influential factors affecting technical efficiency is secondarily assessed in this study.

In the first stage of study, technical efficiency of DHs is calculated for two consecutive years. Solar years of 1389 and 1390 are selected

for the purpose of this study. DEA tool was applied to calculate technical and scale efficiency of all hospitals. In the second stage, determinants of hospital efficiency which had been selected on basis of literature review and contextual issues are regressed against a number of utilization factors of hospitals using censor regression analysis (Tobit model).

Type and Source of Data

Cross sectional data was used from Afghanistan's HMIS database for the solar calendar of 1389 and 1390. Available secondary data Set includes different numerical variables. For the purpose of efficiency determination with DEA, a set of input variables (number of physicians, midwives, nurses, number of non-medical staff, and number of bed) and set of output variables (number of outpatient visits, number inpatient admission and number of patient days). Also, determinant of hospital efficiency (average length of stay, bed occupancy rate, number of patient days, number of hospital beds which is a proxy for hospital size, bed-physician and outpatient physician ratio and physician number) is taken from HMIS data base and used in the study.

Conceptual Framework

This study is consisted of two stages. In the first stage, Technical Efficiency (TE) of the District Hospitals (DHs) in Afghanistan was calculated by DEA. Input and out orientated measurements is required to find out efficiency scores (Ozcan and Luke, 1993). In this study, input orient-ated DEA is used because there might be no or less control over output indicators of hospitals. Technical efficiency scores are estimate-ed from the underlying assumption of Variable Return to Scale (VRS). Mean of Scale efficiency scores of DHs are compared in two different years to see if they are critically different on basis of their scale pattern.

In the second stage, factors affecting efficiency (Determinants of hospital efficiency) are identified using econometric technique of

Tobit regressions analysis. The conceptual framework of this study is illustrated in Figure 1.

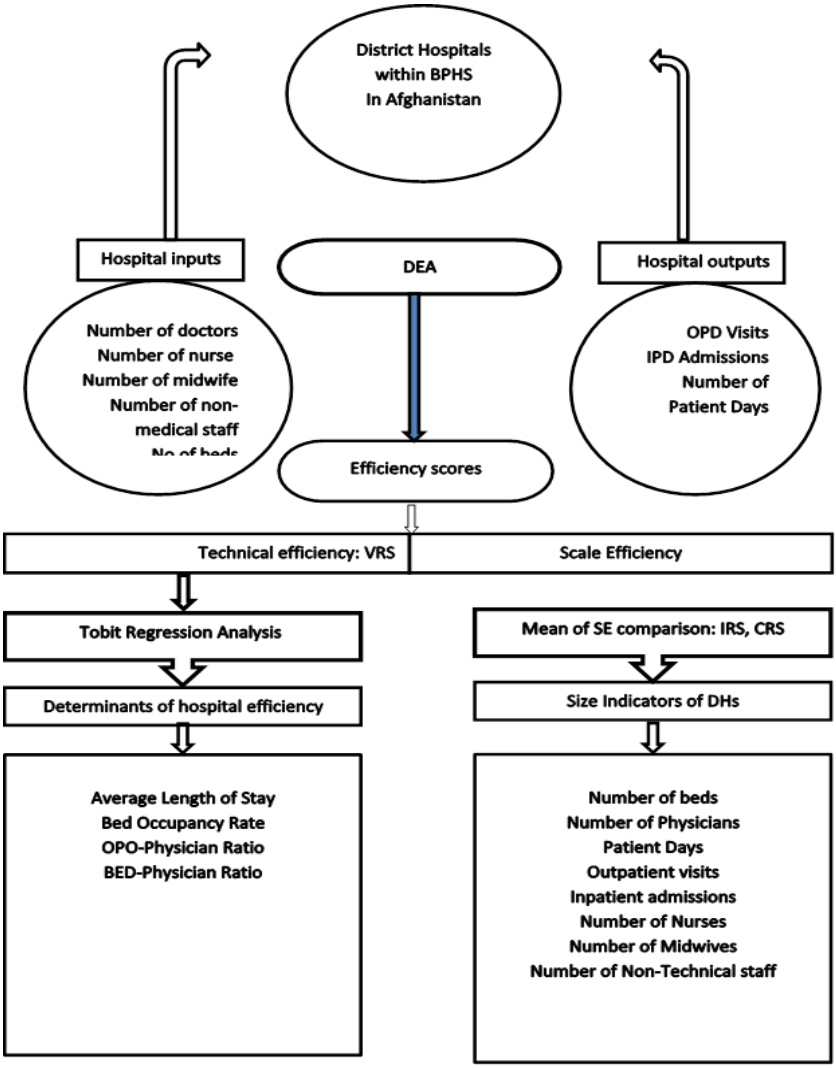

Figure 1 Conceptual Framework of the study

Data Envelopment Analysis Approach

Current study has two stages. In the first stage DEA will be used to calculate efficiency scores of DHs. In the second stage, econometric Tobit model was applied using explanatory variables mentioned in the illustration of conceptual framework.

DEA is a commonly used data orientated approach. Evaluation of performance in an entity or a group of peer entities and firms is easily estimated and quantified by this approach. Generally speaking, a set of peer entities or firms are called Decision Making Units (DMUs). In a DMU, there are many inputs and outputs and its definition depends on the founder of that specific DMU. No specific and constant definition can be given. Recent research papers indicate that DEA is widely used for evaluation of performance in various kinds of entities, activities, different countries and contexts (Coelli, 2008). For instance, DEA is used to analysis performance of hospitals in the healthcare industry, universities, military institutions, courts, business entities, cities, countries and ultimately performance of regions. DEA is very famous for having no or less assumptions behind. Sometimes existence of many heterogeneous inputs and outputs make it impossible for other methods to estimate efficiency of DMUs. However, DEA is totally desirable in these aspects. Besides above given simplistic characteristics of DEA, it is an effective tool to provide s standard benchmarks in many applied studies. As it is commented by Cooper, Seiford and Zhu (2011), DEA has recently distinguished some shortcomings related to profitability of firms which were estimated by other methods (Muening, 2007). Previously, other estimation techniques found inefficient firms to be efficient and considered them as benchmarking for performance of other firms. Similarly, DEA has reconsidered pre and post-merger performance of the banks and stock markets. After introduction of DEA in its current form, many institutions found that DEA is a smart methodology for modeling operational process for performance evaluations. Simultaneous attempts have been made since its first introduction (Zuckerman, Hadley and Izzoni, 1994).

He introduced some spreadsheet models of DEA to for evaluation of performance and benchmarking. Moreover, simplicity of DEA in terms of not having prior and complicated standard assumptions such as standard form of statistical regression analysis, paved the way for its unconceivable applications in many different institutions.

Current form of DEA is first introduced by Charnes, Cooper, and Rhodes (1978). They described DEA as a "mathematical programming model applied to observational data that provides a new way of obtaining empirical estimates of relations-such as the production functions and/or efficient production possibility surfaces-that are cornerstones of modern economics".

Later on, DEA is defined to be a methodology with presenting a frontier rather than a central tendency measure such fitting a regression plan through the center of the data as in statistical regression. Therefore, DEA simplify hidden relationships between inputs and outputs of DMUs very explicitly which still hidden in other methodologies. Definition of efficient or inefficient DMUs is very clear and straightforward which is totally different from linear or non-linear regression models with predefined assumptions (Cooper, Seiford and Zhu, 2006).

Relative efficiency which refers to pure technical efficiency is explicitly defined on basis of the following definitions in DEA methodology without any prior modeling or assumption:

Efficiency-Extended Pareto-Koopmans Definition: Full (100%) efficiency is attained by any DMU if and only if none of its inputs or outputs can be improved without worsening some of its other inputs or outputs. In most management or social science applications the theoretic-ally possible levels of efficiency will not be known. The preceding definition is therefore replaced by emphasizing its uses with only the information that is empirically available as in the following definition:

Relative Efficiency: A DMU is to be rated as fully (100%) efficient on the basis of available evidence if and only if the performances of other DMUs does not show that some of its inputs or outputs

can be improved without worsening some of its other inputs or outputs.

For the sake of simplicity in application of DEA as the selected methodology, the term DMUs is used. These units have the capability to convert given inputs into outputs. It's understood that these DMUs can be public agencies or not for profit private institutions with some comparable or non-comparable characteristics.

To be more specific let's say that there are n hospitals as DMUs in this study to be evaluated. Each hospital (DMU) consumes many different inputs to produce different outputs. Concisely, every DMUj use Xij amount of inputs (i) and make Yrj of output (r).

It is simply assumed that $Xij \geq 0$ and $Yrj \geq 0$. Furthermore, we assumed that every individual DMU has at least one positive input and one positive output.

Based on evidences from the many research paper in healthcare industry, ratio-form of DEA is considered to be the most appropriate form of DEA. This form is called CCR model. In this form the ratio of outputs to inputs is considered to measure the relative efficiency of the DMUj and J=1, 2, 3…..n. Actually, the CCR model is the reduction form of multiple outputs / to multiple inputs and it is indicated as single output/ single input for every DMU existed in this study. This ratio is the function of multiplier and measure efficiency of a specific DMU. Mathematically, this ratio which is shown as maximized form is the objective function of the every DMU.

$$Maxh0\ (u, v) = \sum ur\ ,yr0\ /\ \sum vi\ ,xi0$$

In the above formula, ur's and the vi's and the yr0's and xi0's are the given output and input values, respectively of DMU0.

In the given formula, we can put some constraints which help us to assume that efficiency score of every DMU within this study is 1 or less than 1 and thereafter it can be elaborated as following.

$$Maxh0\ (u, v) = \sum ur\ ,yr0\ /\ \sum vi\ ,xi0$$

Subject to

$$\sum ur\ ,yr0\ /\ \sum vi\ ,xi0 < 1 \text{ for } j = 1, \ldots, n,$$

$$ur, vi \geq 0 \text{ for all i and r.}$$

Censor Regression Analysis

To determine and understand influential factors affecting technical efficiency of the DHs in Afghanistan, estimated efficiency scores for every individual hospital will be regressed to a number of utilizeation variables (ALOS, BOR, bed-physician and outpatient physician ratios) as a dependent variable. Tobit regression analysis is used for this purpose.

Tobit regression or censor regression model is an extension form of probit regression. It was first developed by James Tobin. It's a choice model for specific conditions such as limited dependent variable which is true in case of DEA result. It is evident that technical and scale efficiency scores of DEA result are exactly between zero and one. Nevertheless, in practice, efficiency scores are not equal to zero. The fundamental understanding of Tobit model can be explained as follows:

$$y'i = \beta 1 + \beta 2Xi + ui$$

is considered as a latent variable which is observed for the values greater than truncation point (T) (In this study 1) and censored otherwise. Therefore, observed y can defined as bellow:

$$y' = \begin{cases} y' \ if \ y' > T \\ T \ y \ if \ 1 \leq 1 \end{cases}$$

The model with an assumption of T=1 (observations are censored at 1). Then the equation can be presented as follow:

$$y' = \begin{cases} y' \ \ if \ y' > 1 \\ 1 \ \ \ if \ 1 \leq 1 \end{cases}$$

Research Result

General Description of Data

Table1 presents changes between the solar years[2] 1389 and 1390 in DHs. Average length of Stay (ALOS) and Bed Occupancy Rate

[2] The period of time during which Earth completes a single revolution around the sun, consisting of 365 days, 5 hours, 49 minutes, and 12 seconds of mean solar time.

(BOR) are improved in 1390 in DH. In addition, utilization of services; inpatient admissions and outpatient visits indicate a 10% and 11% increase in 1390 respectively. It can be inferred from the above table that Human Resources were underutilization in 1389 because more Outputs were produced in 1390 with reduced number of Human Resources.

Table 1 Total number of inputs and outputs

Name of Variables	1389	1390	Changes in %
Total Number of Beds	2151	2116	-2%
Total Number of Inpatient admission	158779	174978	10%
Total Number of Outpatient Visits	3782351	4195618	11%
Total Number of Patient Days	397148	426221	7%
Total Number Doctors	406	398	-2%
Total Number of Nurses	944	902	-4%
Total Number of Midwives	240	245	2%
Total Number of Non-Medical Staffs	1089	1047	-4%
Mean of Bed Occupancy Rate	50	59	20%
Mean of Average Length of Stay	6.0	3.7	-39%

Efficiency Results from DEA Model

The result manifests that the average VRS TE and CRS TE of District Hospitals in 1389 are 0.897 and 0.721 respectively. VRS TE and CRS TE in 1390 are found slightly lower than the year 1389. This implies that DHs had been less efficient in the year 1390 than 1389 although level of production was comparatively higher in the year

March 19 of Gregorian calendar is considered the first day of solar calendar each year.

1390. In addition, it can be said that if hospitals had functioned efficiently, they could have produced 11% and 12% more outputs given their available resources.

Table 2 presents the frequency of technical efficiency scores in the year 1389 and 1390. In 1389, 28 (42%) out of 68 hospitals were technically fully efficient with efficiency score of 1.00. Rest of the hospitals showed technical efficiency score of less than 1; 26 (38%), 13 (19%) of DHs had an efficiency levels of (80-99%) and (60-79%) respectively. It is worth to mention that only one hospital which composes 1% of total observations were functioning with an efficiency score of less than 60%. In 1390, less than half of the hospitals (44%) were technically efficient. 26% of the hospitals had efficiency score of (80-99%) while 17 hospitals were between (60-79%) and finally 3 hospitals had below 60% level of efficiency.

Table 2 Descriptive statistics of DEA results

	1389		1390	
	VRS TE	**CRS TE**	**VRS TE**	**CRS TE**
Mean	0.897	0.721	0.883	0.691
Median	0.959	0.733	0.952	0.664
Maximum	1.000	1.000	1.000	1.000
Minimum	0.393	0.195	0.541	0.086
Std. Dev.	0.130	0.229	0.136	0.242
Number of Observations	68.000	68.000	68.000	68.000

Frequency of Technical Efficiency scores

Table 3 indicates pattern of efficiency levels in the year 1389 and 1390. It is clearly obvious that overall efficiency scores are marginally reduced in 1390. However, number of hospitals at (80-99%) level of efficiency had been in 1389 considering to 1390.

Table 3 Frequency of Technical Efficiency Scores for DHs in the year 1389 and 1390

Level of Efficiency	1389		1390	
	Number of DH	%	Number of DH	%
100%	28	42%	30	44%
80-99%	26	38%	18	26%
60-79%	13	19%	17	25%
<60%	1	1%	3	4%
Total	68	100%	68	100%

Input Savings

DEA results provide us with information that could be used as decision making tool to redistribute input resources in order to bring inefficient hospitals to efficient frontiers. Table 4 provides summary information on actual and excess inputs within DHs in 1389 and 1390.

Table 4 Summary of input Slacks in DHs in 1389 and 1390

	1389		1390	
	Actual	Excess	Actual	Excess
Number of Doctors	411	46.30	398	29.97
Number of Nurses	949	19.57	904	11.06
Number of Midwives	240	20.51	245	12.28
Number Non-Medical staff	1062	10.46	1046	11.45
Number of Beds	2151	97.87	2116	70.50

Output Inducement

Similar to input slacks, DEA provide data on required magnitude of the Hospitals output in order to make them fully efficient. Table 5 shows summary of outputs shortfall for 1389 and 1390. As far as the issue of outputs is concerned, they are mainly consumer related facets of input-output mix. However, MoPH or hospital managers may think

about some policies such as demand side financing to increase overall outputs in the district hospitals.

Table 5 Output shortfall in DHs in 1389 and 1390

Variables	1389		1390	
	Actual	Shortfall	Actual	Shortfall
Number of Outpatient Visits	3,782,351	326,922	4,195,618	611,256
Number of Inpatient Admissions	158,190	13,537	174,978	6,963
Number of Patient Days	391,984	17,119	426,221	13,793

Result of Tobit Regression Analysis

As it is already mentioned, at the second stage of this study Efficiency scores (VRSTE) of two years 1389 and 1390 are regressed against a group of hospital utilization outputs. Tobit Regression Model has been applied to see magnitude and direction of efficiency determinants in the hospitals. The model is given in the below:

$$RSTE = \beta 0 + \beta 1 * ALOS(Average\ Length\ of\ Stay + \beta 2 * BOR(Bed\ Occupancy\ Rate) + \beta 3 * BEDPH(Bed\ Physician\ Ratio + \beta 4 * OPDPHY(Outpatient\ physician\ ratio) + \varepsilon$$

There are four utilization variables in the above equation. Average Length of Stay (ALOS), Bed Occupancy Rate (BOR), Bed-Physician Ratio and Outpatient-Physician Ratio are the given independent variables. VRS Technical Efficiency is the dependent variables in the equation.

Table 6 Result of Tobit Regression Analysis VRSTE in 1389

Name of Variable	Coefficient and Standard error
BOR	0.001 (0.0006)
ALOS	0.005 (0.0066)
OPDPHY	0.00003*** (0.00)
BEDPHY	-0.003 (0.0105)
Pseudo R-Square	1.07
Number of observation	68
Chi Square	0.000
Left censored observation	0
Right Censored observation	30
Uncensored observation	38

It can be seen from the above result that, among all utilization variables, outpatient physician ratio is significant. Other variables in the model have indicating expected signs and they are all positively correlated with the technical efficiency scores. It should be said that Bed physician ratio may have positive and negative signs based on the context. To illustrate, sometimes managing too many beds by a doctor will lead the inefficiency of hospitals. On the other hand, failure of to manage reasonable number of beds by a doctor would cause inefficiency. Furthermore, pseudo R-square has no meaning for the Tobit model. From all the above observations, 38 hospitals have indicated uncensored status. Thirty hospitals showed censored status to the right.

Table 7 Result of Tobit Regression Analysis for VRSTE in 1390

Name of Variable	Coefficient and Standard error
BOR	0.004 (0.001)
ALOS	0.010 (0.006)
OPDPHY	0.00001*** (0.000)
BEDPHY	-0.002 (0.006)

Table 7 (Continue)

Name of Variable	Coefficient and Standard error
Left censored observation	0
Right Censored observation	30
Uncensored observation	38

As it is indicated in the result of Tobit regression analysis, among all the utilization variables, coefficient of outpatient-physician ratio is also significant as the year 1389. All other variables with expected sign of coefficients are not significant at 5% level of significance. Thirty of observations are equaled uncensored while 38 of the hospitals are censored at right.

Scale Efficiency analysis of District Hospitals

For the analysis of scale efficiency of hospitals in two different study periods, mean of size variables for the hospitals indicating IRS, CRS and DRS are calculated and thereafter compared. Gaps between two mutually exclusive variables are evaluated. The wider the gap, the critical is the variable.

Table 8 Scale Efficiency Analysis in the Year 1389

Size Variables	Increasing Return to Scale (IRS)	Constant Return to Scale (CRS)	Decreasing Return to Scale (DRS)
Number of Beds	30.94	28.88	80
Number of Physician	6.08	5.31	10
Patient Days	4,491.16	8,486.49	22,660
Outpatient Visits	48,256.43	77,158.91	38,474
Inpatient Admission	1,718.71	3,843.83	7,316
Number of Nurse	12.45	13.28	89
Number of Midwives	3.51	2.97	10

Table 8 (Continue)

Size Variables	Increasing Return to Scale (IRS)	Constant Return to Scale (CRS)	Decreasing Return to Scale (DRS)
Number of Non-Medical staff	14.02	14.81	96

Mean of size variables are calculated among IRS, DRS and CRS hospitals was calculated in the above table. It is found that among all the size variables in the DHs in the year 1389, only two of them; patient days and outpatients visits are considered to be critical variables because there is big gap among IRS and CRS hospitals. Only one hospital has shown DRS and its size variables are not significantly different from other hospitals with IRS and CRS.

Table 9 Scale Efficiency analysis in the Year 1391

Size Variables	Increasing Return to Scale (IRS)	Constant Return to Scale (CRS)
Number of Beds	31.85	28.75
Number of Physician	5.88	5.81
Patient Days	5,515.44	8,713.63
Outpatient Visits	62,500.92	59,098.13
Inpatient Admission	2,298.10	3,467.31
Number of Nurse	12.42	16.13
Number of Midwives	3.63	3.50
Number of Non-Medical staff	14.73	17.50

Above table is indicating comparative result of size variables mean in the year 1390. There are a number of size variables with critical gaps among CRS and IRS hospitals. Patient days, number of

nurse, number of non-medical staff with having the biggest gap are significant variables. Therefore, significant size variables should be closely evaluated in order to change the IRS hospitals (those too small) to an optimal size of functionality. Furthermore, it can be seen that number admissions is not a good size variable for the DHs in the year 1390.

Discussion

Technical Efficiency Analysis of District Hospitals

The result of input orientated DEA indicated that from 68 District Hospitals in Afghanistan, 28 (41%) and 30 (44%) of them were fully efficient in the years 1389 and 1390 respectively. Most of the inefficient hospitals had efficiency scores between 0.99 and 0.6. However, 1 (1%) and 3(4%) of the DHs displayed efficiency scores of less than 0.6 in the years 1389 and 1390 respectively. Maximum efficiency scores were 1 for both period of the study while 0.393 and 0.541 were minimum scores for 1389 and 1390 respectively. The mean of technical efficiency scores was reduced by 0.014 in 1390. In both years of study, almost all the DHs indicated an Increasing Return to Scale (IRS) of Inefficiency Patterns. Only one DH displayed Decreasing Return to Scale (DRS) in the year 1389. Excess numbers of Labour and Capital resources are identified. Overall, 46 doctors, 20 nurses, 21 midwives, 10 non-medical staff and 98 beds were underutilization in the year 1389. Similarly, 30 doctors, 11 nurses, 12 midwives, 11 nonmedical staffs and 71 beds were found to be excess in the year 1390.

Tobit Regression analysis of VRSTE of District Hospitals

Result of Tobit regression analysis revealed that among all the factors that were regressed against pure technical efficiency scores, outpatient visits/physician ratio was significantly correlated with efficiency of District Hospitals in 1389 and 1390. It is found that if number of outpatient physician ratio increase by one than efficiency

scores of district hospitals would increase by 0.00003 and 0.00001 respectively for the year 1389 and 1390. Average Length of Stay, Bed Occupancy Rate and Bed Physician ratios are indicating coefficients which are compatible with the expected signs, yet their signs found to be insignificant. For both years of study 38 DHs are remained uncensored while remaining 30 hospitals found to be censored at the right. Likewise, psedo R square which is indicating the goodness of fit in the model are higher than one. However, its importance for the Tobit model is under question.

All given information can be used as policy tools for redistribution of excess resources among DHs throughout the country. Furthermore, Shortfalls of DHs outputs are pinpointed and it could be evidence based facts for policy analysis at MoPH level.

Analysis of Scale Efficiency in the District Hospitals

Result of scale efficiency analysis of district hospitals using their mean comparison within the IRS, CRS and DRS hospitals, shows that Patient days and outpatient visits are the most critical variables in the year 1389. There is a difference of 3995 patient days between mean of CRS and IRS hospitals. Likewise, mean number of outpatient visits is 28,902 OPD less in the IRS hospitals than CRS hospitals. Rest of the variables is not significantly different.

Comparative result of size variables within IRS and CRS hospitals in the solar year 1390 indicates a number of variables with wide gap. Patient days, number of admissions, number of nurse, number of non-medical staff. The difference among means of patient days, number of admission, number of nurse and number of non-technical staff is 3198, 1169, 3.7 and 2.7 respectively for the year 1390.

Limitation of study

First of all, DEA does not have the capability to estimate random noise (emergence of epidemics, natural and man-made disasters, security issues), and hence, it inadvertently attributes any deviation from frontier to inefficiency. Consequently, by applying DEA we may have overlooked the existing magnitudes of inefficiencies in the study.

Further to that, it would be argued that the ultimate output of hospitals is the aggregate change in health status of the patients who received hospital outpatient and inpatient services. Due to the lack of data on health status indices such as Quality Adjusted Life Years or health disability (QALY) indicators or Disability Adjusted Life Years (DALY), this study used intermediate outputs, such as number of outpatient visits and number of hospital admissions. Moreover, If I had had the chance to use ultimate health outcomes, it would have been the issues of attribution and thereafter the need to totally control the exogenous factors.

More than to that, it is quite difficult to ensure the data quality of all the given outputs and inputs in this study (such as desirable outpatient visits and inpatient admissions in terms of full recovery from diagnosed disease, or differences in the level of severity) and inputs (identify skill and hardworking aspects of health workers who are considered as inputs). Furthermore, a number of some other variables such as catchment area, education level and security status of the each district should have been collected and evaluated. However, mentioned data was not available.

Finally, unavailability of health system inputs prices hampered estimation of allocative efficiency, and hence, calculation of total economic efficiency of hospitals.

Conclusion and recommendation

Analyses and result of this study displayed wide range areas regarding human and capital resource distribution and application of efficiency benchmarking which all need be focused.

First of all, excess medical and non-medical labor forces should be closely evaluated. Based on a recent study by Health Economics and Financing Directorate (HEFD) of the MoPH, staff salaries are the main cost driver (61%) in Kabul's hospitals (MoPH, 2012). In addition Cost Analysis of BPHS-2012 indicated that salaries and wages compose 43% of total BPHS cost. Therefore, human resources should be used wisely in order to make the inefficient hospitals element of efficient frontier. It is suggested to reduce number of doctors and nurse and

instead improve other health facilities within BPHS with excess staff of DHs. To illustrate, total number of slack inputs; doctors, nurses, midwives, non-medical staff and beds were 46.30, 19.57, 20.51, 10.46 and 97.87) in the Solar year of 1389. Similarly, slacks of the total number of doctors, nurses, midwives, non-medical staffs and beds were found 29.27, 11.06, 12.28, 11.45 and 70.50 in the year 1390. Even though result of the study indicates that excess number of human and capital resources have been reduced during the two consecutive years of the study, more decrease in the excess number of resources could have brought the inefficient hospitals to the efficient frontier. Consider to other Labour forces in the DHs, number of mid-wifes is almost at efficient level. Furthermore, result of this study has shown that number of Beds as an indicator of Capital Resources is high. It can be compensated with inducement of DHs inpatient service utilization.

Besides adjustments to Labour and Capital resources, Scale Efficiency and patterns of DEA results can be used by policy makers at MoPH level to upsize DHs. Comparative analysis of DHs size variables within the IRS, CRS and DRS hospitals, shows that number of patient days and outpatient visits should have been improved at the hospitals with IRS pattern by 3995 and 28902 in 1389 while patient days and inpatient admissions needs improvement by 3198 and 1669 respectively in order to bring inefficient hospital to an optimal size of functionality in the hospitals with Increasing Return to Scale (IRS) patterns, improvement in the number beds would make the hospital efficient. Nevertheless, evidence based input-output mix is necessary to have fully efficient hospitals.

Finally, methods of efficiency measurement and benchmarking should be incorporated and institutionalized with Health Management Information System (HMIS) systems. It will provide evidences to local administrator of the DHs to make their hospitals efficient.

To sum up, wise allocation of human and capital resources, thinking about effective polices to increase demand for health services utilization and institutionalization of efficiency measurement methods

are considered of paramount importance aspects and implication of this study.

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