EFFICIENCY DIFFERENCES ACROSS LEVELS 2 & 3 HEALTH CARE FACILITIES IN KENYA

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REGISTRATION NO: X50/64275/2011

A Research Project Submitted to the school of Economics, University of Nairobi, in Partial fulfillment of the requirement for the award of the Degree of Masters of Arts in Economics.

October 2013

DECLARATION

This research paper is my original work and has not been presented for a degree award in any other university.

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ACKNOWLEDGEMENT

I would like to acknowledge those institutions and individuals whose contributions have made the preparation of this project paper possible. My first gratitude goes to Almighty God for enabling me complete this course.

I am greatly indebted to my supervisors Dr. Urbanus Kioko and Prof. Germano Mwabu, who without their guidance and advice the paper would not be complete. I would also like to appreciate Terry Watiri from the Ministry of Health for her support towards completion of this research paper.

Finally, I thank the University of Nairobi for giving me the opportunity to undertake my post graduate studies. May the almighty God bless everyone who directly or indirectly assisted me to complete this project paper.

DEDICATION

This research paper is dedicated to my loving husband James Gikundi Kaberia, my lovely daughter Shirleen Kendi and the entire family who has supported me throughout the period.

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ABSTRACT

With the enactment of the Kenya constitution 2010, devolution evolved which entailed the introduction of the counties. In the process, there are various reforms that have taken place in the health sector. One of the major reforms undertaken includes channeling of the resources directly to level 2 and 3 facilities. Therefore service delivery as a result of devolution becomes important and there is need to establish the level of efficiency in these facilities.

This study examines the usefulness of Data Envelopment Analysis in establishing the level of efficiency among level 2 and 3 health facilities. These facilities act as the first point of entry by patients. The main objective of the study was to determine the levels of efficiency across the primary health facilities in Kenya. The study uses a sample of forty seven (47) health centres and forty seven (47) dispensaries across all the forty seven (47) counties in Kenya.

The results indicate that the average technical efficiency among health centres is 68.8% which implies that on average the facilities should reduce their inputs by 31.2% without reducing the levels of outputs. In addition, 25.5% (12) health centres had efficiency scores of 100%. On the other hand, the overall average of technical efficiency among the dispensaries is 61% implying that on average the facilities has inefficiency utilized inputs by 39% without reducing the levels of outputs. Regression results from the sampled health centres and dispensaries across the country shows that immunizations and outpatients visits are positively related to both Constant Returns to Scale (CRS) and Variable Returns to Scale (VRS) efficiency scores.

CHAPTER ONE: INTRODUCTION

1.1 Background

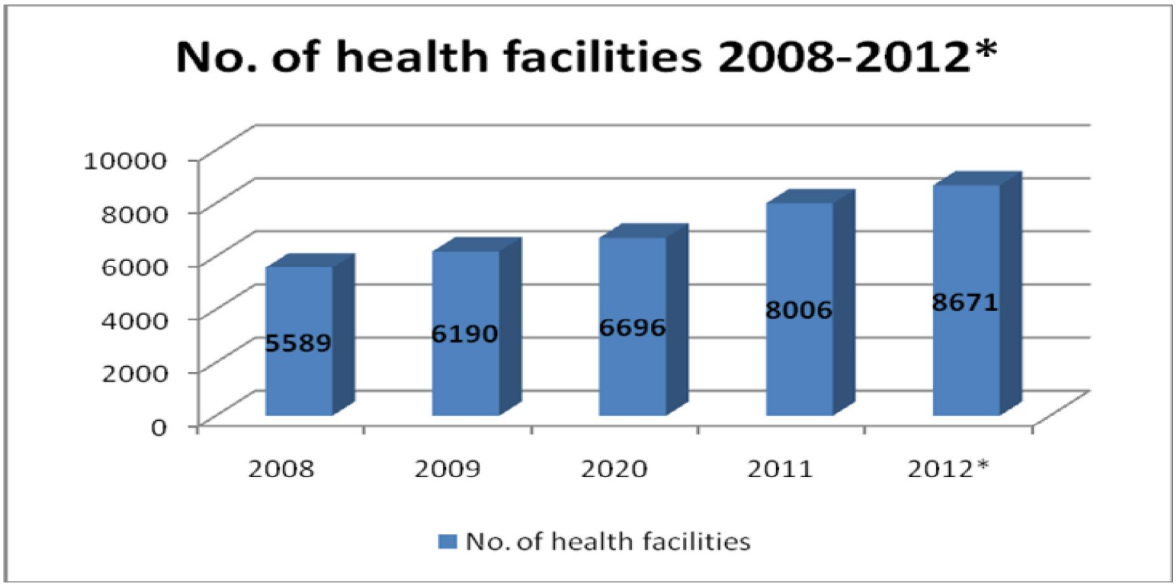
Health system consists of organizations, people and actions whose primary intent is to promote and maintain health care delivery (WHO, 2000). For a system to improve heath and health equity in a responsive, financially fair and efficient manner, service delivery, health workforce and financing needs to strong. This can be achieved by transformations which have been evident in the formulation of policies and reforms in the world over. The policies and reforms generated are geared towards enhanced efficiency. The ideal systems used in the world over include full government financed system which is through taxation, the use of sickness or the utilization of both and or the use of out of pocket health care system.

In Kenya, various health care systems have been applied since the 1960's where the government financing system was adopted. In the 1970's and 1980's, the government also introduced a sickness fund to supplement the financing system. This was due to an emphasis on primary health care. In the 1990's and 2000, health care decentralization was operationalized in order to ensure efficiency in health care delivery in the country (Kimuyu et al., 1999, WHO, 2000, MoH, 1994). In this case the National Health Insurance was introduced with part of out-of-pocket health care system introduced.

Reforms in the Kenya Health sector

To enhance service delivery, the government has implemented several reforms which have seen the number of health care facilities increase from 5,500 in 2008 to 8000 in 2011 as shown in the table below:

Figure 1: increase in the number of health facilities



Source: MOE, 2012

The increasing number of health facilities and the enactment of the Constitution of Kenya, 2010 justified the process of devolution of health care which was preceded by decentralization. Decentralization became one of the major reforms undertaken in the health sector. Traditionally Health system decisions in Kenya have been carried out by the Ministry of Health (MOH) headquarters through top- down management and resource allocation despite efforts to involve the lower level facilities. This central health system has been criticized for promoting disparities in resource allocation and accelerating inequalities in access of quality health services. In the year 2008, changes in the health sector made it easier for the lower level facilities to manage their own development funds for the service delivery enhancement.

According to Ndayi et al., (2009), decentralization of the health care management was important in order to improve decision making power for resource allocation and quality service delivery at the district level. As a result of decentralization the public health system in

Kenya was organized in hierarchical manner which consisted of the following levels of the health facilities; national referral hospitals, provincial general hospitals, district hospitals, health centres, and dispensaries. National referral hospitals are at the apex of the health care system while dispensaries and health centres are meant to be the first contact with the patients. The Kenya Health Policy emphasis on equitable and affordable health care and ensure this is achieved through strengthening planning and monitoring processes relating to health care provision to ensure that demand driven priorities are efficiently and effectively implemented (Kenya Health Policy 2012). It is therefore evident that efficiency in all the health system levels varies from one level to the other (Kirigia, et al, 2000; Kioko, 2000; Mutuku, 2008).

Government intervention in health care efficiency

Efficiency in health care refers to the extent to which a health Decision Making Units (DMU) uses its available resources which are inputs to produce the maximum possible health related outputs (Farrell, 1957). In Kenya health resources are scarce but this does not mean that inefficiency should be prevalent since the available scarce resources can be used in the best optimal way to maximize output. The inputs utilized include the health care providers, the infrastructure and financing. The Health facilities are financed through taxation, user fees, donor funds and health insurance as pointed clearly in the Kenya's health policy framework of 1994. In non- governmental sector health facilities are financed through insurance premiums and revenue collected from user fees. According to the NHSSP 1999-2004 is that funds shall target cost effective interventions in order to reduce the disease burden and improve health status in the community.

The government support to the health sector is evident by the increasing budgetary allocation to the facilities. During 2008/09 financial year, the health sector was allocated 32.9 billion shillings by the government of Kenya while in 2009/10 financial year the sector was allocated 39.9 billion shillings. This allocation represented 7 percent of the total estimated government budget and 1.7 percent of the gross domestic product. The health sector recorded an increase in the budget allocations in the subsequent years. Recurrent budget estimates for the primary health services increased significantly by 8 percent and 26.2 percent in 2010/11 and 2011/12 financial years respectively. On the other hand, development budget also increased for the primary health services due to major constructions at the district level (Economic Survey, 2012).

In the past two years, the real allocations to the public sector have declined. However Statistics shows that health sector recurrent budget is far much higher than the development counterpart. In 2013 the reviews of public expenditure and budgets shows that 8.6% is the total health spending of total government expenditure. This allocation is below 15 percent target of the Abuja Declaration (Abuja, 2001)

After the enactment of the Kenya constitution in 2010, the management of health care services was devolved, with the county governments managing the health facilities in their areas of jurisdiction. The implementation process of the County Health Management Board (CHMB) would ensure that the activities of the primary health facilities are carried out effectively to enhance service delivery. The roles of CHMBs is to represent community interests in the health planning processes, review and participate in the budget preparation of the county and make policy recommendations for the health facility in the county among others.

The existence of dispensaries and health centers are a major source of primary health care in Kenya. This entails community involvement and the use of local human and physical resources to provide curative and preventive services and health promotion. The performance of these primary health care facilities is determined by the utilization of the available scarce resources. Nana Enyimayew, 2004, points out that efficiency of the health service delivery is improved through reducing wastages of inputs which determines the level outputs generated.

In order to improve efficiency among level 2 and 3 health care facilities, Kenya adopted millennium Development Goals and health sector reforms. These goals were aimed at making the country to attain a middle income country status by the year 2030. In line with the Vision 2030, Kenya aims at restructuring the health delivery system and also shifts the emphasis to promotive care in order to lower the nation's disease burden. The Goal of Vision 2030 will therefore be achieved through implementation of the medium term and strategic plans which include various reforms to improve primary health care facilities.

1.2 Statement of the problem

Several reforms have been undertaken in the country to ensure that primary health facilities are efficient. One of the major reforms relates to resources that are being channeled directly to primary health facilities. Other health financing reforms include output based funding for maternal health care. These reforms are expected to have improved the performance of these facilities. With the ongoing devolution of service delivery it will be important to obtain information on the level of efficiency of these facilities. In addition it will be necessary to assess the causes of in (efficiency) of the facilities in order to enable the county governments to design measures for improving the value for money. Apart from the study by Kirigia (2000) , Nzoya (2001) and Mutuku (2008) on the efficiency of health centres and dispensaries, there has not been any further attempt to estimate the efficiency of primary health facilities after the enactment of the Constitution of Kenya, 2010 yet several reforms to improve their performance have been instituted. This study therefore aims to fill this information gap.

1.3 Objectives of the study

1.3.1 General Objective

The broad objective of the study was to determine the levels of efficiency across primary health facilities and the factors influencing efficiency in these facilities in Kenya after the enactment of the Constitution of Kenya, 2010.

1.3.2 Specific objectives

The specific objectives were:

1. To estimate the technical efficiency of level 2 and 3 primary health facilities
2. To determine factors responsible for inefficiency of primary health facilities in Kenya
3. To suggest policy recommendations based on the study findings

1.4 Justification of the study

Assessing efficiency of primary health facilities in the counties will generate information that will be useful for policy, planning and operational management of the identified causes of inefficiency in these facilities. The results will provide health planners in the counties with useful information on the optimal size or the levels of inputs required in each of the primary health facility in order to enhance efficient administration.

On the other hand, the findings will enable the health management in the counties to identify the inefficient health centres and dispensaries with a view to finding solutions to improve their efficiency. In addition, the county health management board that run the primary health facilities in the decentralized reforms would apply the findings and improve efficiency, equity and customer satisfaction as stipulated in the Kenya Health Policy, 2004. The above mentioned can be achieved through identification of the efficient and inefficient primary health facilities, the cause of inefficiency and using appropriate policies so as to improve efficiency. Finally the knowledge of efficiency across primary health facilities will help planners to identify feasible policies for either reducing inputs or increasing the level of outputs so as to improve efficiency.

1.5 Organization of the paper

The paper is organized in five chapters. Chapter one discusses the background of the study, the study objective and the justification of the paper. Chapter two discusses the literature review which includes the theoretical literature, the conceptual literature and the empirical literature. The study methodology is discussed in chapter three while chapter four look at the study findings with chapter five making conclusions and recommendations.

CHAPTER TWO: LITERATURE REVIEW

2.0 Introduction

This chapter provides a review of theoretical literature on technical efficiency across primary health facilities, it also looks at the methods used in the estimating efficiency for example Data Envelopment Analysis (DEA) and empirical evidence on the efficiency levels in the health facilities.

2.1 Theoretical literature review

Efficiency studies are based on the amount of outputs that are produced with a given inputs. This is the process of production which is well explained by Euler's theorem of production. The theorem states that when F(L,K) is a production function , then the Euler's theorem says that if factors of production are paid according to their marginal productivities the total factor payment is equal to the degree of homogeneity of the production function times output. The case of n=1 is an important special case. For that case if factors of production are paid according to their marginal productivities then output will exactly cover the factor payments.

However, there is no unified theory of measuring efficiency in hospital behavior, but there are different models for measurement according to the role of external and internal factors (Gerdtham et al 1994). A hospital is said to be technically efficient if an increase in an output requires a decrease in at least one other input, or an increase in at least one other input or a decrease in at least one output (Matarradona 1990). To characterize the production technology relative to which efficiency is measured each hospital uses vector inputs $x = x_1,.......x_N) \in R^M{}_+$, to produce vector of outputs $y = (y_1,.........y_M) \in R^M{}_{+\,1}$. Inputs are transformed in to outputs using a technology that can be described by a graph

[1] $x = x_1,.......x_N) \in R^M{}_+$ and $y = (y_1,.........y_M) \in R^M{}_+$ are scalar elements contained in a vector space since they are non-empty and closed under vector addition through an origin and their first differential is equal to zero.

$: GR = (x, y)$ where x can produce y (Debreu 1951; Farrell 1957). Correspondingly there is a family of input set: $L(y) = \{x : (x, y) \in GR\}, y \in R^M{}_+$. Input set satisfy the properties of convexity and strong disposability of inputs. Inputs set contain their isoquants: Isoq $L(y) = \{x : x \in L(y), \theta x \notin L(y), \theta \in (0,1)\}, y \in R^M{}_+$ which in turn contain their efficient subsets:

Eff $L(y) = \{x : x \in L(y), x' \notin L(y), x' \leq x\}, y \in R^M$ then a radial measure of the technical efficiency of input vector x in the production of output vector y is given by: TE_1(x,y)=min $\{\theta : \theta_x \in L(y)\}$ where $\theta = 1$ indicates radial technical efficiency and $\theta \prec 1$ shows the degree of radial technical efficiency[2]. (Debreu 1951; Farrell 1957).

2.2 Conceptual Literature

This is the literature that pertains to articles or books written by authorities giving their opinions, experience and theories on efficiency in the decisions making units. Coelli 1996, explains that the overall or technical economic efficiency (TEE) of a decision making unit (DMU) consist of two basic components which include Technical efficiency (TE) and Allocative efficiency (AE). Technical Efficiency is a measure of how well an individual transforms inputs into a set of outputs based on a given set of technology and economic factors. This means the ability of a firm to produce maximum possible output given the available resources (Aigner, et al., 1977; Kumbhakarand Lovell, 2000).

[2] The output y is produced by the elements in x, whereby the scalar multiplication by elements in x, may not produce the output y, even though the vector θ is within the boundary of (0, 1). However output y lies within the vector space of the x and y elements. Therefore any change of x elements to x' will not produce output y, since y is in the original vector space. θ is efficiency, whereby a facility is efficient when θ is 1 but less than one otherwise.

Allocative efficiency is said to exist when a health facility reflects the ability to use available inputs in optimal proportions to attain the maximum possible net benefit from their use. This implies that when an efficient allocation of the resources has been attained, it is not possible to increase the efficient performance in one health facility without having a shortage/excess in another health facility.

Economic efficiency describes how well a health care system is performing in generating the maximum desired output for a given inputs with available technology. The efficiency holds if no one can be made better off without making someone else worse off. On the other hand, scale efficiency explains whether a health care system as a whole is producing services at least cost. It is achieved in the short run and by the size which has an impact on its operating costs

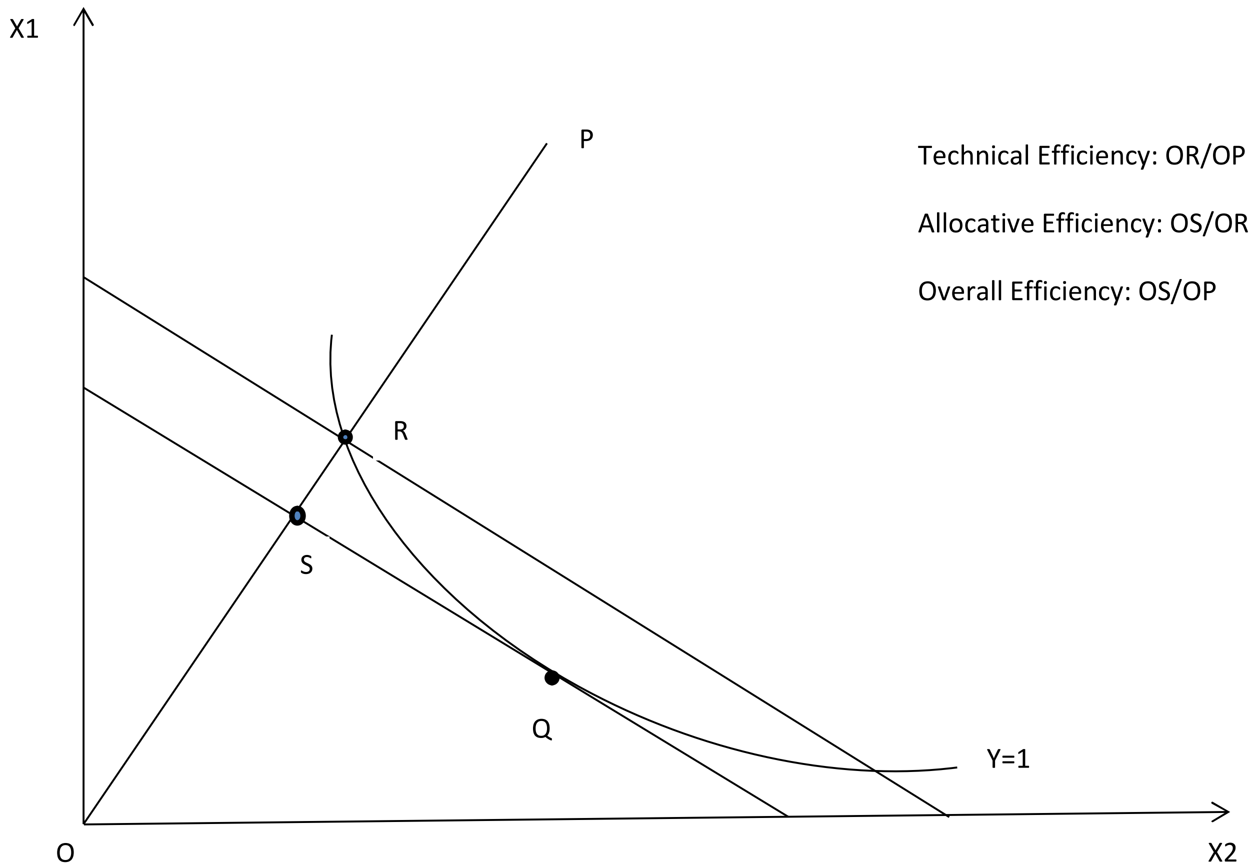
From economic literature, efficiency is therefore refers to the ability of firm to derive maximum outputs from scarce inputs (Farrell, 1957). This definition was influenced by (Koopmans 1951) formal definition and (Debreu 1951) measure of technical efficiency while using input and output approaches. According to Koopmans (1951), "*a producer is 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 and if a reduction in any inputs requires an increase in at least one other input or a reduction in at least one output''.* This implies that efficiency in the primary health facilities depends mostly on the inputs and outputs used.

To explain efficiency in a given DMU, Farrell analyzed different ways of establishing an inefficient productive unit by obtaining less than maximum output available from a group of input which is technically inefficient or allocative efficiency which can be attained by not purchasing the best package of inputs given their prices and marginal productivities.

2.3 Diagrammatic Explanation of efficiency

Figure 2 below shows a firm that produces a single output y using two inputs (X1 and X2), under the assumption of constant returns to scale. The unit isoquant $Y = 1$ represents a fully technically efficient firm and all the points lying on it are technically efficient. Point P is technically inefficient since it lies off the isoquant and in order to make it efficient the distance to point R should be reduced. The technical inefficiency of point P is measured by the relative distance from the frontier RP (Farrell, 1957). The magnitude of the efficiency can be expressed as the ratio between optimal and actual resource use (OR/OP). By taking into account the isocost line (representing relative factor prices), we can identify allocative efficiency. Allocative (price) efficiency can be expressed as the ratio between minimum and actual cost (OS/OR), and overall efficiency is the product of technical and allocative efficiency.

Figure 2: Efficiency Concepts



Source: Farrel, 1957

Charnes et al., (1984) points out that taking into consideration the assumption of constant returns to scale, the efficiency of primary health facility *p* can be estimated. The objective function is to maximize the efficiency score E for primary health facility *p* subject to the constraints that no primary health facility will be more than 100% efficient and the coefficient values are positive and non-zero when a set of *v* and *u* coefficient are applied to all other primary health facilities being compared.

$$Max\ E_p = \sum u_r\ Y_{rp}$$

s.t. $\sum v_i\ X_{ip} = 1$

$$\sum u_r Y_{rj} \sum v_i\ X_{ij} \leq 0$$

Vi,…,vs > 0

u_i,…,$u_m > 0$

r= 1,…, s

1=1,…, m

J=1,…, n

Where E_p is the efficiency score of for primary health facility p.

The following are the input output variables;

Y_{rp} is the actual amount of output r produced by primary health facility p

X_{ip} is the actual amount of input I used by primary health facility p

u_r is the weight to output r

v_i is the weight of input I

s is the number of outputs

m is the number of inputs

n is the number of primary health care facilities

The first constraint indicates that the weighted sum of inputs for a particular primary health care facility equals one while the second constraint indicates that all primary health care facilities are on or below the frontier. Both weights are determined by using data envelopment analysis model. Using this model means that constant return to scale is only appropriate to the primary health care facilities which are operating at optimal scale.

2.4 Empirical literature review

Kirigia et al., (2000) estimated efficiency of public sector hospital in South Africa using 155 primary health care clinics in Kwanzulu Natal Province and found that a significant number of facilities were inefficient. The results further revealed that only 47 (30%) of the clinics included in the sample were technically efficient. Similar findings were reported in Kenya but the recommendation was to reduce the inputs which were number of nurses and those of general staff or alternatively to increase the output in order to attain the required level of efficiency.

In addition, while using DEA Kirigia et al., (2000) and Nzoya et al., (2001) assessed technical and allocative efficiencies in 32 public health centers in Kenya. Outputs used were family planning visits, immunization visits, STI visits, respiratory disease visits and general outpatients' visits while the inputs were clinical officers, medical laboratory staff, beds, non wage recurrent expenditure and price. The aim of the study was to assess technical allocative efficiency and the major factors which are likely to influence their performance. The results of the study revealed that 28% of the public health centers had some degree of technical inefficiency. Thus in order to eliminate inefficiency, the number of inputs should be reduced. The same results were related to a study by Owino and Korir (1997) on public health sector efficiency in Kenya. They used stochastic frontier analysis on 72 hospitals and established a mean technical inefficiency of 29.6 % portraying that on average, the hospitals' were about 70% efficient in their inputs.

In Sierra Leone, Kirigia et al., (2000) evaluated 37 health units using DEA model. Total number of antenatal plus post natal visits, number of child deliveries, child growth monitoring visits, number of family planning visits, and the number of children under the age of five years plus pregnant women immunized with toxoid and total number of health education sessions conducted were used as outputs while technical staff and subordinate staff were used as inputs. 65% of the health units were found to be scale inefficient while 35% were technically inefficient. The results according to the study shows that in order for inefficient health health units to operate efficiently, outputs should be increased by about 22% without changing the quantity of inputs used (Kirigia et al., 2000).

A similar study was done in Ghana in 17 health centres and 17 district hospitals where the outputs used were health services and factors of production were used as inputs (Kirigia et al., 2005). The results obtained showed that 18% of the sampled facilities were technically efficient with an average of technical efficient of 61% for the district hospitals. On the other hand 18% of the health facilities were technically efficient but the average technical efficiency was 49%. In order to further improve this, the study advocated for sector reforms and monitoring of the reform implementation.

Osei et al., (2005) established technical efficiency in public health centers in Ghana. The inputs for the study were the number of the technical staff and support staff while the outputs were number of children immunized, outpatient curative care, child care and maternal care programs among others. The findings pointed out that out of 17 health centers only 3 health centers were inefficient while the other 14 health centers were efficient and his major policy recommendation was to encourage the use of primary health care services in the country.

Kioko (2000) carried out a study on the impact of decentralization reform to determine the hospital efficiency. He used three outputs which included outpatients' visits, inpatients visits and cost recovery ratio while the inputs used were resources represented by recurrent total expenditure and bed size. The DEA method was used in a censored regression model and the resulted were clear that inputs should be reduced in order to achieve technical efficiency. Medical staff was found to be negative and statistically significant at 5% level implying that on average an increase in the total number of medical personnel by one would lead to a reduction of hospital's efficiency while bed occupancy rate was found to be positive and statistically significant at 1% level.

Another study was carried out by New Brander et al., (1993) where he used bed occupancy level as the ratio for efficiency comparison within provincial and district hospitals and health centres in Zimbabwe. Bed occupancy level was 91% of the provincial hospitals and 76% of the district hospitals and the results revealed that provincial hospitals were more efficient than district hospitals. It was recommended that in order to raise the level of efficiency in the district hospitals, bed occupancy rate should be increased. The overall efficiency for the whole country was found to be 89%.

Gerdtham et al., (1994) on the other hand analyzed technical efficiency in three teaching hospitals in Malaysia using Data Envelopment Analysis, constant returns to scale and input oriented model. The results showed that 87.5% of the selected clinical departments were inefficient while 12.5% of the selected clinical department were efficient and therefore the need to reduce inputs to increase efficiency in the hospitals.

In Korea a study on technical efficiency was carried out in 560 hospitals. DEA model was used to measure technical efficiency where 16 outputs and 8 inputs were used. The results showed that regarding pure technical efficiency, 25.8% of the hospitals were efficient. Those regarding variable returns to scale (VRS) model 37.1% were efficient while the scale efficiency was found in 30.6% hospitals which were efficient (Wong 1996).

Zere (2000) employing a DEA based Malmquist approach examined hospital efficiency in 86 three levels public hospitals in South Africa for the fiscal year 1992/93- 1997/98. The changes in the productivity were determined by use of DEA Marginal productivity Index (MPI). Inputs used were recurrent expenditure and bed size while the outputs were inpatients days and out patients visits. The findings of the study were that level one public hospitals were technically efficient as compared to levels two and three. The range of the overall level of technical efficiency for the three levels of hospitals examined ranged from 35%- 47% with only 12.8% of the public hospitals being efficient as compared to their peers.

2.5 Overview of the Literature

The literature reviewed identified the various major causes of inefficiency in levels 2 and 3 in various countries which ranges from the un-utilized inputs, medical personnel like nurses and clinical officers, expenditure on drugs, reduced inpatient and outpatient visits, and poor administrative and managerial structures.

Kirigia et al (2000), Kioko (2000), Nzoya et al.,(2000) and Korir and Owino (1997) evaluated the level of efficiency in Kenya in levels 2 and 3. They identified inefficiencies and recommended the need for input and output adjustment to improve the level of efficiency. In addition their studies employed use of DEA in measuring the efficiency since it is effective in estimating the level of efficiency in health institutions due to data specification and availability.

CHAPTER THREE: METHODOLOGY

3.0 Introduction

This chapter outlines the methodology used in the study. It will employ the use of secondary data gathered from the various health centres and dispensaries in Kenya. In this regard, Data Envelopment Analysis (DEA) method will be used to determine the level of efficiency of each health centre and dispensary sampled.

3.1 Measurement of efficiency

The efficiency in level 2 and 3 can be measured using traditional methods and new approaches. Traditional methods include the ratio analysis while the new approach encompasses parametric and non parametric approaches.

Ratio analysis

This is the simplest method of estimating efficiency by dividing outputs with inputs. This is a method where by efficiency is determined in primary health care facilities taking into account bed management, unit cost per service and productivity of the staff which includes admission of cases per doctor (Lertiendumrong, 2003).

$$\text{Efficiency} = \frac{\text{Outputs}}{\text{Inputs}}$$

Due to the limitations of the ratio analysis, advanced approaches like parametric and non-parametric should be used to gauge the overall performance of the primary health facilities.

The parametric approach

This is the approach that imposes a functional form on the production function and is used in the estimation of the production frontiers (Lovell and Schmidt 1988). . The commonly used functional forms include constant elasticity of substitution and cob Douglas functions.

Stochastic frontier approach

Aigner et al (1997), explains the differences between stochastic frontiers and deterministic frontier. There is allowance for the stochastic errors due to measurement errors in stochastic frontiers. Assuming a suitable production function where all firms are producing in a technically efficient manner the stochastic frontier can be defined as follows:

$$Q = f(y_i, \propto) + V_i + \mu_i \qquad \mu_i \leq 0$$

Q Maximum output obtainable from y_i

y_i Is a vector of non- stochastic inputs

α Is the unknown parameter to be estimated

$V_i + \mu_i$ Is the error term component

On the other hand, deterministic frontiers assume that all deviations from the frontier are as a result of firm's inefficiency.

The non- parametric approach

This approach is based on linear programming which consists of estimating a production frontier through a convex envelope curve formed by line segments joining observed efficient production units. The most popular non- parametric approach is Data Envelopment Analysis (DEA) which will be used in this study to estimate technical efficiency in primary health care facilities.

3.2 Methodology

Data Envelopment Analysis is a linear programming methodology for evaluating relative efficiency of each production unit among a set of homogeneous Decision Making Units (DMUs) developed by Charnes, Cooper and Rhodes (1978). The model can produce many outputs from many inputs thus making estimation of efficiency easy. This model assumes Constant Returns to Scale (CRS). The second model developed assumed Variable Returns to Scale (VRS) and separated pure technical efficiency from scale efficiency (Banker et al 1984).

$$Max\ E_p = \sum u_r\ Y_{rp}$$

Subject to

$$.\sum v_i\ X_{ip} = 1 \qquad (1)$$

$$\sum u_r Y_{rj} - \sum v_i\ X_{ij} \leq 0$$

$$Max\ E_p = \sum u_r\ Y_{rp} + W_p$$

s.t. $\sum v_i\ X_{ip} = 1$ (2)

$$\sum u_r Y_{rj} - \sum v_i\ X_{ij} + W_p \leq 0$$

Vi,…,vs > 0

u_i,…,$u_m > 0$

r= 1,…, s

1=1,…, m

J=1,…, n

Where E_p is the efficiency score of for primary health facility p.

The following are the input output variables;

Y_{rp} is the actual amount of output r produced by primary health facility p

X_{ip} is the actual amount of input I used by primary health facility p

u_r is the weight to output r

v_i is the weight of input I

s is the number of outputs

m is the number of inputs

n is the number of primary health care facilities

With the notations the same as those in constant returns to scale model as reflected in model (1) above, one can derive scale efficiency. The additional W component corresponds to an intercept which is unconstraint sign (Bjurek et. al 1990). In order to determine whether it is constant return to scale or variable return to scale the following is used;

i) If $W_p < 0$ then there is increasing return to scale

ii) If $W_p = 0$ then there is constant return to scale

iii) If $W_p > 0$ then there is decreasing return to scale

Data Envelopment Analysis Model has been commonly used due to the following advantages (Berg 2010). It does not require the assumption of a functional form relating inputs and outputs. This means that there is no need to explicitly specify mathematical form for the production function. Secondly, decision making units can be directly compared against a peer where the sources for inefficiency can be analyzed and quantified. Thirdly, the model inputs and outputs can have different units. Fourthly, it can handle multiple inputs and multiple outputs and lastly, the model is proven to uncover relationships that are hidden for other methodologies

Although the model has the above mentioned advantages, it also has the following limitations which should be kept in mind to know whether to use the model or not. First, it is difficult to carry out statistical hypothesis test. Secondly, the results of this model are sample specific and are sensitive to the selection of outputs and inputs and finally the model measurement error can cause significant problems

DEA deals with identification of units which uses inputs for the given output in most optimal manner. The information obtained is used to calculate the efficiency of the other organization units which do not fall on the efficient frontier. According to Coelli et al (2003), Data Envelopment Analysis can either be output oriented or input oriented. In the case of the output oriented, the DEA method seeks the maximum possible proportional increase in output production with the input levels being constant. On the other hand, the input oriented case, the DEA method seeks maximum proportional reduction in the input usage with output levels held constant.

The efficiency scores of the study will be determined through use of input- oriented, constant and variable returns to scale DEA model. An input oriented model is used because the primary health facilities managers will have control of the demand side factors (Zere 2000).

3.2 Model Specification

The DEA model applied by Kirigia et al., (2000) has been used to determine the efficiency among health centers and dispensaries in the country. It is assumed that under the restriction, each of the health facility efficiency is determined by regressing against its individual criteria.

The efficiency of a target unit Ep is obtained as a solution to the maximization problem and thus the algebraic model in equation (2) can be written as;

$$Max\ Ep = \frac{\sum m_{rl}\ y_{rl}}{\sum n_{ji} x_{ji}}$$

Subject to

$$\frac{\sum m_{rl}\ y_{rl}}{\sum n_{ji} x_{ji}} \leq 1$$

$$m_r, n_j \geq 0 \qquad (3)$$

Where

Ep is the efficiency of health facility p to be estimated

m_r and n_j are the inputs and outputs variables to be estimated in the model

y_i are the outputs of the *i* th unit

x_i are the inputs of the *i* th unit

r indicates the t different outputs

j indicates the q different inputs

It is worth to note that the DEA problem of equation (2) is a fractional linear program where the objective function is maximized while the subjective function is minimized. Hence it can be converted into linear form and linear programming is applied. This is carried out by setting the denominator equal to a constant and maximizing the numerator. Applying the transformation developed by Charnes et al., (1978) the model become;

$$Max_{m,n}\, Ep = \sum m_{rl}\; y_{rl}$$

Subject to

$\sum m_{rl}\; y_{rl}$ - $\sum n_{ji} x_{ji} \leq 0$; for each unit i

$n_{ji}, x_{ji} = 1$ (4)

$m_r, n_j \geq \varepsilon$

Where

Ep is the efficiency of health facility p to be estimated

m_r *and* n_j are the inputs and outputs variables to be estimated in the model

y_i are the outputs of the *i* th unit

x_i are the inputs of the *i* th unit

r indicates the t different outputs

j indicates the q different inputs

3.3 Regression of Efficiency Scores

The DEA model gives the overall technical efficiency and the regression model was used to detect if the measures of inefficiency are related to factors that causes it. With the guidance of the Greene (1993), the empirical form will be:

INEF= β0 + β1 MP + β2EXP + β3 IMM+ β4 OPD+ Ɛ

Where:-

INEF is inefficiency

MP is the Medical personnel by cadre

EXP is expenditure in the primary health facilities

IMM is the immunization

OPD is the outpatient visits

Ɛ is the error term

3.4 DEA inputs and outputs

In order to estimate efficiency of the primary health care facilities the study will use two inputs namely; Medical personnel by cadre and expenditure in the primary health facilities and two outputs namely; immunization and outpatient visits. The choice of outputs and inputs has been guided by the understanding of the dispensaries and health centre (Kirigia et al 2000) and the data availability.

3.5 Data sources and Analysis

The study utilizes the cross sectional data for the sampled health centres and dispensaries. This secondary data will be drawn mainly from Ministry of Health for the health centres and dispensaries who offers homogenous primary health care services. The sample of the health centres and dispensaries was drawn from all the forty seven counties in the country. In each county, there is one health centre and one dispensary that has been sampled and analysed. The analysis was undertaken using DEAP 2.1 econometric software (Coelli, 1996). The DEA efficiency scores are the used as the dependent variable in the Ordinary Least Squares regression model to determine the factors causing the inefficiency. This study assumes that the allocations of the funds among the health centres are the same and the same case applies the allocations of the dispensaries. Therefore, in the regression the expenditure component is exempted due to the problem of collinearlity with the dependent variable.

CHAPTER FOUR: STUDY FINDINGS AND DISCUSSION

4.0 Introduction

This is the chapter that explains the results obtained to guide whether health centre or a dispensary will need to reduce inputs or increase production. Further, the summary statistics on technical efficiency are presented followed by a discussion of findings on returns to scale.

4.1 Technical Efficiency

As pointed earlier, there are forty seven (47) health centres and forty seven (47) dispensaries sampled from all the counties in the Kenya. For all the sampled health facilities, there is an observable deviation of efficiency scores from the best practice frontier which is clearly presented by the summary of efficiency scores in tables 1 and 2 respectively.

Table 1: Summary of efficiency results from Health Centres

	Overall Technical Efficiency (CRS)	Pure Technical Efficiency (VRS)	Scale Efficiency (CRS / VRS)
Mean	0.6881	0.6960	0.9856
Median	0.6728	0.6798	0.9969
Std.Deviation	0.2460	0.2423	0.0388
Min. Value	0.2223	0.2243	0.9911
Max. Value	1.0000	1.0000	1.0000
Total No. of facilities on frontier	12	29	24

The results from the health centres shows that the overall average of technical efficiency is 68.8% which implies that on average the facilities has inefficiency utilized inputs by 31.2% without reducing the levels of outputs as illustrated in table 1. In addition, 25.5% (12) health centres had efficiency scores of 100% under pure technical efficiency score. The results further shows that health centres sampled performed better under scale efficiency than under pure technical efficiency. This is because the average pure technical efficiency score of the sampled health centres is 0.6881 while the average scale efficiency score of the same facilities is 0.9856.

Table 2: Summary of efficiency results from Dispensaries

	Overall Technical Efficiency (CRS)	Pure Technical Efficiency (VRS)	Scale Efficiency (CRS / VRS)
Mean	0.6105	0.6495	0.9300
Median	0.5666	0.6693	0.9871
Std.Deviation	0.3014	0.3011	0.0828
Min. Value	0.2205	0.2469	0.8929
Max. Value	1.0000	1.0000	1.0000
Total No. of facilities on frontier	11	25	22

The results form Table 2 indicates that the overall average of technical efficiency of the sampled dispensaries is 61% which implies that these facilities can reduce the use of their inputs by 39% without reducing the levels of outputs. Under pure technical efficiency score, 23.4% (11) dispensaries had efficiency scores of 100%. On average, the pure technical efficiency score of the sampled dispensaries is 0.6105 while the average scale efficiency score of the same facilities is 0.9300. This implies that dispensaries sampled performed better under scale efficiency than under pure technical efficiency.

4.2 Health centres Variable Returns to scale/ Constant Returns to scale results

According to Coelli, 1996, using Data Envelopment Analysis (DEA) identifies the optimal input output combination and presents it with best practice frontier. The technically efficient decision making units that make up the frontier are assigned a score of one. Results from table 3 below shows that 12 out of 47 (25.5%) health centres are technically efficient since they had a score of 100%. The technically efficient health centres included Gongoni, Shimba Hills, Bura, Garsen, Kamutei, Kathonzweni, Gobei, Isinya, Huruma, Kilibwoni, Kerio and Mtayos. However, 35 out of 47 (74.5 %) health centres did not attain the efficiency score of one.

Table 3: Variable Returns to scale/ Constant Returns to scale DEA efficiency results for Health Centres

Facility Name	Facility Code	CRSTE	VRSTE	CRSTE/ VRSTE	Returns to scale
Githunguri	1	0.8732	0.8976	0.9728	IRS
Kabare	2	0.6589	0.6625	0.9946	IRS
Gatura	3	0.3937	0.3937	1.0000	–
Kaimbaga	4	0.4068	0.4132	0.9845	DRS
Bellevue	5	0.4740	0.4980	0.9518	IRS
Gongoni	6	1.0000	1.0000	1.0000	–
Shimba Hills	7	1.0000	1.0000	1.0000	IRS
Kiunga	8	0.5253	0.5260	0.9987	IRS
Kisimani	9	0.6788	0.6798	0.9985	IRS
Bura	10	1.0000	1.0000	1.0000	–
Garsen	11	1.0000	1.0000	1.0000	–
Kanja	12	0.6953	0.6953	1.0000	IRS
Kinna	13	0.8028	0.8053	0.9969	–
Kamutei	14	1.0000	1.0000	1.0000	–
Kaviani	15	0.9779	0.9927	0.9851	DRS
Kathonzweni	16	1.0000	1.0000	1.0000	IRS
Dabel	17	0.3154	0.4254	0.7414	DRS
Akachiu	18	0.7061	0.7445	0.9484	IRS
Mpukoni	19	0.6728	0.6848	0.9825	IRS
Bahati	20	0.8035	0.8132	0.9881	DRS
Kora kora	21	0.3789	0.3789	1.0000	–
Banisa	22	0.4239	0.4239	1.0000	–
Alimaow	23	0.5230	0.5520	0.9475	IRS
Kitare	24	0.5442	0.5567	0.9775	IRS

Iranda	25	0.5839	0.5873	0.9942	DRS
Lumumba	26	0.7556	0.7630	0.9903	IRS
Mariwa	27	0.3341	0.3368	0.9920	IRS
Endiba	28	0.4898	0.4898	1.0000	–
Gobei	29	1.0000	1.0000	1.0000	–
Kituro	30	0.5961	0.5984	0.9962	IRS
Bomet	31	0.7126	0.7232	0.9853	IRS
Kapteren	32	0.6458	0.6463	0.9992	–
Isinya	33	1.0000	1.0000	1.0000	–
Ainamoi	34	0.8561	0.8721	0.9817	IRS
Huruma	35	1.0000	1.0000	1.0000	–
3KR	36	0.6618	0.6632	0.9979	IRS
Kilibwoni	37	1.0000	1.0000	1.0000	IRS
Olokurto	38	0.3057	0.3142	0.9729	IRS
Kisima	39	0.3861	0.3925	0.9837	IRS
Kwanza	40	0.3905	0.3905	1.0000	–
Kerio	41	1.0000	1.0000	1.0000	IRS
Chembulet	42	0.4916	0.4946	0.9939	IRS
Alale	43	0.2223	0.2243	0.9911	DRS
Bumula	44	0.9024	0.9084	0.9934	DRS
Mtayos	45	1.0000	1.0000	1.0000	–
Bukura	46	0.6397	0.6397	1.0000	IRS
Ekwanda	47	0.5143	0.5235	0.9824	IRS

4.3 Dispensaries Variable Returns to scale/ Constant Returns to scale results

Table 4 shows that 12 out of 47 (25.5%) dispensaries are technically efficient since they had a score of 100%. The DEA approach enables the change to Variable Returns to Scale (VRS). This change relaxes the simplistic assumption that inputs normally will move in exact proportions to the scale of operations and allows for the existence of economies and diseconomies of scale. The VRS Data Envelopment Analysis further decomposes this overall technical efficiency score into pure technical efficiency as shown in column 4 and scale efficiency as depicted in column 5.

Table 4: Variable Returns to scale/ Constant Returns to scale DEA efficiency results for Dispensaries

Facility Name	Facility	CRSTE	VRSTE	CRSTE/ VRSTE	Returns to scale
Gachika	1	0.5527	0.5582	0.9901	IRS
Gatuto	2	0.5194	0.5973	0.8696	DRS
Gathaithi	3	0.3185	0.3982	0.7998	DRS
Kirima	4	0.3127	0.3158	0.9901	IRS
Gakawa	5	0.6767	0.6856	0.9871	IRS
Junju	6	1.0000	1.0000	1.0000	_
Bofu	7	0.5355	0.6693	0.8000	DRS
Kizingitini	8	0.3453	0.3754	0.9199	IRS
Bokole	9	0.9826	0.9826	1.0000	_
Kighombo	10	0.2336	0.2397	0.9747	IRS
Meti	11	0.1458	0.1634	0.8925	IRS
Ena	12	0.4378	0.4422	0.9901	IRS
Badana	13	0.1531	0.1621	0.9442	IRS
Itoleka	14	1.0000	1.0000	1.0000	_
Katani	15	0.6398	0.8445	0.7576	IRS
Liani	16	1.0000	1.0000	1.0000	IRS
Kargi	17	0.4569	0.4589	0.9957	_
Gitura	18	1.0000	1.0000	1.0000	_
Gianchuku	19	0.3460	0.3467	0.9980	DRS
Pumwani	20	1.0000	1.0000	1.0000	IRS
Daley	21	0.5037	0.5037	1.0000	IRS
Guba	22	0.8251	0.8263	0.9986	IRS
Batalu	23	0.5666	0.5723	0.9901	DRS
Gongo	24	0.4770	0.4961	0.9615	IRS
Egotonto	25	0.8568	0.9853	0.8696	DRS
Miwani	26	0.3255	0.3417	0.9524	IRS
Angaga	27	0.2852	0.3337	0.8547	IRS
Ensakia	28	0.2804	0.3364	0.8333	DRS
Anyuongi	29	0.6930	0.8663	0.8000	DRS
Chesongo	30	0.1677	0.1928	0.8696	DRS
Belgut	31	1.0000	1.0000	1.0000	_
Anin	32	0.3409	0.3443	0.9901	IRS
Enkirgir	33	0.2205	0.2866	0.7692	IRS
Chebirbei	34	0.2287	0.2561	0.8929	IRS
Matanya	35	1.0000	1.0000	1.0000	_
Eburru	36	0.8612	0.9904	0.8696	DRS
Cheplengu	37	0.2447	0.3303	0.7407	IRS
Enoosupukia	38	1.0000	1.0000	1.0000	IRS

Ledero	39	0.4543	0.4543	1.0000	IRS
Goseta	40	0.6702	0.8177	0.8197	DRS
Nameyana	41	1.0000	1.0000	1.0000	IRS
Chepkemel	42	1.0000	1.0000	1.0000	IRS
Annet	43	0.7797	0.8577	0.9091	IRS
Siboti	44	1.0000	1.0000	1.0000	_
Budalangi	45	1.0000	1.0000	1.0000	_
Masaba	46	0.6548	0.7727	0.8475	DRS
Mutisinyi	47	0.6025	0.7230	0.8333	DRS

Summary of Input Targets for Health Centres

Input target is generated automatically form the DEA analysis results. The inputs change is obtained from the difference between the input target and the actual number of input in the decision making unit. Level 2 and 3 health facilities should have an input target to be technically efficient. Results from table 5 indicate that 70.2% (33 out of 47) health centres have sufficient inputs since their input change is Zero. However, Olokurto and Alale health centres requires a reduction of 3.3 and 4 of the medical personnel respectively. The other health centres which requires a reduction of their inputs includes Kisimani, Kanja, kina, Akachiu, Bahati, Kora kora, Lumumba, Mariwa, kituro, kapteren, Chembulet, and Isinya.

Table 5: Summary of Input Targets for Health Centres

Facility Name	Facility Code	Input(1) target-Medical Personnel	Input change
Githunguri	1	27	(0)
Kabare	2	341	(0)
Gatura	3	38	(0)
Kaimbaga	4	6	(0)
Bellevue	5	9	(0)
Gongoni	6	14	(0)
Shimba Hills	7	4	(0)
Kiunga	8	7	(0)
Kisimani	9	8	-(2)
Bura	10	5	(0)
Garsen	11	9	(0)
Kanja	12	10	-(1)

Kinna	13	3	-(4)
Kamutei	14	5	(0)
Kaviani	15	9	(0)
Kathonzweni	16	12	(0)
Dabel	17	7	(0)
Akachiu	18	9.4	-(3.6)
Mpukoni	19	16	(0)
Bahati	20	69	-(8)
Kora kora	21	6	-(4)
Banisa	22	9	(0)
Alimaow	23	5	(0)
Kitare	24	13	(0)
Iranda	25	13	(0)
Lumumba	26	11	-(4)
Mariwa	27	25	-(7)
Endiba	28	6	(0)
Gobei	29	4	(0)
Kituro	30	20	-(5)
Bomet	31	10	(0)
Kapteren	32	25	-(2)
Isinya	33	18	-(4)
Ainamoi	34	7	(0)
Huruma	35	12	(0)
3KR	36	15	(0)
Kilibwoni	37	9	(0)
Olokurto	38	29.7	-(3.3)
Kisima	39	33	(0)
Kwanza	40	30	(0)
Kerio	41	7	(0)
Chembulet	42	12	-(3)
Alale	43	8	-(4)
Bumula	44	22	(0)
Mtayos	45	17	(0)
Bukura	46	31	(0)
Ekwanda	47	16	(0)

Summary of Output targets for Health Centres

Similarly, table 6 results depict that 26 (53.3%) health centres sampled attained efficient production targets. Bellevue health centre has an excess of output one (outpatient Visits) by a margin of 2,094 but fell short of the second output (immunization) by a margin of 1,648. Similar results show that twelve health centres have excess output which is above the target. From the results obtained, nine health centres have less output than expected which may explain that either more inputs needs to be employed to achieve the target.

Table 6: Summary of Output targets for Health Centres

Facility Name	Facility Code	Output (1)-(Out Patients Visits)	Output (1) change	Output (2)-(Immunizations)	Output (2) change
Githunguri	1	45907	0	5678	0
Kabare	2	34641	0	7645	0
Gatura	3	20697	0	4567	0
Kaimbaga	4	8949	0	3498	0
Bellevue	5	16203	2094	5104	-1648
Gongoni	6	66245	13671	13453	2116
Shimba Hills	7	15657	-3094	6785	-1004
Kiunga	8	12897	-1895	4897	1570
Kisimani	9	24730	0	7674	0
Bura	10	20479	0	7876	0
Garsen	11	45354	5544	10768	4710
Kanja	12	17655	0	8234	0
Kinna	13	17058	0	4567	0
Kamutei	14	12453	-3785	6231	-1864
Kaviani	15	30456	4775	10123	-1554
Kathonzweni	16	33777	0	15234	0
Dabel	17	6702	0	798	0
Akachiu	18	25675	1824	10301	-2845
Mpukoni	19	32456	9732	7653	3305
Bahati	20	27141	0	10234	0
Kora kora	21	10899	0	2345	0
Banisa	22	11132	0	2345	0
Alimaow	23	6234	-2259	1754	813
Kitare	24	10465	-7917	6743	2915
Iranda	25	18678	1246	3478	-804

Lumumba	26	20123	-4573	9276	-931
Mariwa	27	16987	2758	5456	-1089
Endiba	28	12678	4063	2987	2451
Gobei	29	13971	0	4876	0
Kituro	30	25390	0	14491	0
Bomet	31	17686	0	6451	0
Kapteren	32	27503	0	11395	0
Isinya	33	54679	12089	27385	-1037
Ainamoi	34	15020	0	7386	0
Huruma	35	35987	7550	12395	-1939
3KR	36	16743	-4888	10748	4941
Kilibwoni	37	27213	0	14234	0
Olokurto	38	14616	0	8647	0
Kisima	39	18458	0	10328	0
Kwanza	40	18669	0	9476	0
Kerio	41	5689	-1502	2234	3253
Chembulet	42	20969	0	9834	0
Alale	43	10457	3604	4345	3344
Bumula	44	36510	0	25621	0
Mtayos	45	47807	0	28392	0
Bukura	46	30581	0	13498	0
Ekwanda	47	19657	-3607	10231	5443

Summary of Input and output Targets for Dispensaries

Table 7 results illustrate that 63.8% (30 out of 47) dispensaries have sufficient inputs. However, there are 36.2% (17 out of 47) dispensaries which require reduction of the medical personnel. Results from table 8 below shows that 40.4% (19 out of 47) dispensaries have attained their efficient production targets since their output change is zero.

Table 7: Summary of Input Targets for Dispensaries

Facility Name	Facility Code	Input(1) target-(Medical Personnel)	Input change
Gachika	1	3	-(2)
Gatuto	2	5	(0)
Gathaithi	3	16	-(8)
Kirima	4	4	(0)
Gakawa	5	12	(0)

Junju	6	3	(0)
Bofu	7	4	(0)
Kizingitini	8	12	-(6)
Bokole	9	14	-(6)
Kighombo	10	4	(0)
Meti	11	3	(0)
Ena	12	4	-(1)
Badana	13	5	(0)
Itoleka	14	3	(0)
Katani	15	3	(0)
Liani	16	2	(0)
Kargi	17	3	(0)
Gitura	18	5	-(2)
Gianchuku	19	5	(0)
Pumwani	20	75	-(12)
Daley	21	2	(0)
Guba	22	2	-(3)
Batalu	23	4	(0)
Gongo	24	18	-(7)
Egotonto	25	10	-(9)
Miwani	26	6	-(2)
Angaga	27	4	(0)
Ensakia	28	7	(0)
Anyuongi	29	6	(0)
Chesongo	30	5	(0)
Belgut	31	3	(0)
Anin	32	40	-(7)
Enkirgir	33	3	(0)
Chebirbei	34	4	(0)
Matanya	35	5	(0)
Eburru	36	2	-(3)
Cheplengu	37	6	-(1)
Enoosupukia	38	2	(0)
Ledero	39	2	-(3)
Goseta	40	7	-(4)
Nameyana	41	3	(0)
Chepkemel	42	4	(0)
Annet	43	4	(0)
Siboti	44	5	(0)
Budalangi	45	11	(0)
Masaba	46	25	-(7)
Mutisinyi	47	12	(0)

Table 8: Summary of Output targets for Dispensaries

Facility Name	Facility Code	Output (1)-(Out Patients Visits)	Output (1) change	Output (2)-(Immunizations)	Output (2) change
Gachika	1	15948	0	2342	0
Gatuto	2	14988	0	2345	0
Gathaithi	3	9190	0	1673	0
Kirima	4	9022	0	2456	0
Gakawa	5	19528	0	6298	0
Junju	6	28856	0	13324	0
Bofu	7	20567	5116	1209	-5919
Kizingitini	8	12435	2470	3421	-863
Bokole	9	25348	-3006	17563	5616
Kighombo	10	6879	653	5487	2374
Meti	11	3797	0	1943	0
Ena	12	12633	0	5231	0
Badana	13	3426	1262	1245	258
Itoleka	14	13987	-1321	5768	3557
Katani	15	7400	0	3625	0
Liani	16	14438	0	5275	0
Kargi	17	5307	0	2589	0
Gitura	18	20456	3140	8358	1127
Gianchuku	19	6789	1993	2763	532
Pumwani	20	39876	11532	12375	-2169
Daley	21	12345	8198	4538	1881
Guba	22	8452	-3874	4356	-965
Batalu	23	4653	-2720	5349	1917
Gongo	24	9233	0	4234	0
Egotonto	25	15649	0	5341	0
Miwani	26	3768	-941	1873	-472
Angaga	27	3278	-494	2267	517
Ensakia	28	4987	1223	3452	1432
Anyuongi	29	12657	0	4069	0
Chesongo	30	6549	3792	1674	466
Belgut	31	10871	2688	4352	-993
Anin	32	5787	0	2456	0
Enkirgir	33	2789	985	563	-404
Chebirbei	34	45982	42958	2598	1555
Matanya	35	14673	-3591	8435	1230
Eburru	36	10452	-4431	8745	2540
Cheplengu	37	4196	0	1567	0
Enoosupukia	38	239	0	132	0
Ledero	39	7638	2617	1817	-252

Goseta	40	18563	3134	7845	1415
Nameyana	41	3010	0	2090	0
Chepkemel	42	7201	0	3653	0
Annet	43	5437	-1152	6453	3779
Siboti	44	13874	-2032	9875	5466
Budalangi	45	25478	2458	7452	-2842
Masaba	46	11563	-3511	4325	-1003
Mutisinyi	47	16486	2616	3452	-1223

4.4 Econometric Results

In explaining the inefficiency among levels 2 &3, the CRS and VRS and scale DEA scores were taken as the dependent variables. On the other hand, inputs, outputs and ante natal visits were used as independent/explanatory variables. Regression analysis was performed using STATA 10 statistical software. The analysis will determine how the explanatory variables results in (in) efficiency in the health centres and dispensaries. The results are as follows:

Table 9: OLS Estimation Results for Health Centres

	Constant Returns to Scale (CRS)		**Variable Returns to Scale (VRS)**		**Scale Efficiency (SE)**	
Variable	Coefficient Score	P > |t|	Coefficient Score	P > |t|	Coefficient Score	P > |t|
Medical personnel	-0.0010406	0.027	-0.0010556	0.025	0.0000167	0.408
Immunization	8.5×10^{-6}	0.900	9.05×10^{-8}	0.984	1.00×10^{-6}	0.249
Outpatients Visits	0.0000136	0.008	0.0000136	0.007	4.72×10^{-7}	0.372
Constant	0.4039578	0.000	0.418975	0.000	0.9657999	0.000
No. of Observations	47		47		47	
R-squared	0.3735		0.3679		0.0761	

Table 10: OLS Estimation Results for Dispensaries

	Constant Returns to Scale (CRS)		**Variable Returns to Scale (VRS)**		**Scale Efficiency (SE)**	
Variable	Coefficient Score	P > |t|	Coefficient Score	P > |t|	Coefficient Score	P > |t|
Medical personnel	-0.0044394	0.010	-0.0043568	0.009	-0.0004731	0.542
Immunization	0.0000328	0.224	0.000277	0.277	$8.5x10^{-6}$	0.333
Outpatients Visits	0.0000161	0.188	0.0000182	0.118	$5.02x10^{-7}$	0.893
Constant	0.3414953	0.000	0.3793406	0.000	0.9040568	0.000
No. of Observations	47		47		47	
R-squared	0.4287		0.4274		0.0672	

The results obtained from the sampled health centres and dispensaries across the country shows that immunizations and outpatients visits are positively related to both Constant Returns to Scale (CRS) and Variable Returns to Scale (VRS) efficiency scores. As a result, they may lead to increase in the levels of efficiency. On the other hand, medical personnel in the sampled levels 2 and 3 facilities shows a negative relationship to both Constant Returns to Scale (CRS) and Variable Returns to Scale (VRS) efficiency scores thus resulting to inefficiency in these facilities. All the factors are statistically significant for constant returns to scale and variable returns to scale except for the scale efficiency whose results are insignificant for the sampled facilities.

CHAPTER FIVE: CONCLUSIONS AND POLICY RECOMMENDATIONS

5.0 Conclusions

This is a conclusion chapter that gives a brief analysis of the study's crucial findings. The study evaluated technical efficiency and determinants of (in) efficiency of 94 levels 2 and 3 facilities sampled across the country.

The purpose of the study was to determine the levels of efficiency across primary health facilities also referred to as levels 2 and 3 facilities and the factors influencing efficiency in the primary health facilities in Kenya.

The summary statistics from the health centres shows that the overall average of technical efficiency is 68.8% which implies that on average the facilities has inefficiency utilized inputs by 31.2% without reducing the levels of outputs. In addition, 25.5% (12) health centres had efficiency scores of 100% under pure technical efficiency score while the overall average of technical efficiency in the sampled dispensaries is 61% implying that on average the facilities has inefficiency utilized inputs by 39% without reducing the levels of outputs. In addition, 24 out of 94 health centres and dispensaries sampled are technically efficient since they attained a score of one. This represents overall average technical efficiency of 25.5% and this shows that 74.5% of the primary health facilities are inefficient.

As a result the Ministry of Health could scale down the inputs in the health facilities that exhibit decreasing returns to scale. However if the facility is exhibiting increasing returns to scale, the health planners should expand the levels of both outputs and inputs.

5.1 Policy implications and recommendations

From the results obtained in the study, the policy makers can explore the policy options with regard to outputs and inputs. From the sampled facilities, the Ministry of Health (MOH) policy makers could transfers the excess medical personnel by cadre to the understaffed facilities in order to reduce the inefficiency.

In addition the Ministry of Health could carry out a thorough campaign to boost the demand for the unutilized essential services which are encompassed in the out patients visits.

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APPENDICES

Appendix 1: Health centres Summary statistics

Facility Name	Facility Code	CRSTE	VRSTE	CRSTE/ VRSTE	Returns to scale
Githunguri	1	0.8732	0.8976	0.9728	IRS
Kabare	2	0.6589	0.6625	0.9946	IRS
Gatura	3	0.3937	0.3937	1.0000	–
Kaimbaga	4	0.4068	0.4132	0.9845	DRS
Bellevue	5	0.4740	0.4980	0.9518	IRS
Gongoni	6	1.0000	1.0000	1.0000	–
Shimba Hills	7	1.0000	1.0000	1.0000	IRS
Kiunga	8	0.5253	0.5260	0.9987	IRS
Kisimani	9	0.6788	0.6798	0.9985	IRS
Bura	10	1.0000	1.0000	1.0000	–
Garsen	11	1.0000	1.0000	1.0000	–
Kanja	12	0.6953	0.6953	1.0000	IRS
Kinna	13	0.8028	0.8053	0.9969	–
Kamutei	14	1.0000	1.0000	1.0000	–
Kaviani	15	0.9779	0.9927	0.9851	DRS
Kathonzweni	16	1.0000	1.0000	1.0000	IRS
Dabel	17	0.3154	0.4254	0.7414	DRS
Akachiu	18	0.7061	0.7445	0.9484	IRS
Mpukoni	19	0.6728	0.6848	0.9825	IRS
Bahati	20	0.8035	0.8132	0.9881	DRS
Kora kora	21	0.3789	0.3789	1.0000	–
Banisa	22	0.4239	0.4239	1.0000	–
Alimaow	23	0.5230	0.5520	0.9475	IRS
Kitare	24	0.5442	0.5567	0.9775	IRS
Iranda	25	0.5839	0.5873	0.9942	DRS
Lumumba	26	0.7556	0.7630	0.9903	IRS
Mariwa	27	0.3341	0.3368	0.9920	IRS
Endiba	28	0.4898	0.4898	1.0000	–
Gobei	29	1.0000	1.0000	1.0000	–
Kituro	30	0.5961	0.5984	0.9962	IRS
Bomet	31	0.7126	0.7232	0.9853	IRS
Kapteren	32	0.6458	0.6463	0.9992	–

Isinya	33	1.0000	1.0000	1.0000	–
Ainamoi	34	0.8561	0.8721	0.9817	IRS
Huruma	35	1.0000	1.0000	1.0000	–
3KR	36	0.6618	0.6632	0.9979	IRS
Kilibwoni	37	1.0000	1.0000	1.0000	IRS
Olokurto	38	0.3057	0.3142	0.9729	IRS
Kisima	39	0.3861	0.3925	0.9837	IRS
Kwanza	40	0.3905	0.3905	1.0000	–
Kerio	41	1.0000	1.0000	1.0000	IRS
Chembulet	42	0.4916	0.4946	0.9939	IRS
Alale	43	0.2223	0.2243	0.9911	DRS
Bumula	44	0.9024	0.9084	0.9934	DRS
Mtayos	45	1.0000	1.0000	1.0000	–
Bukura	46	0.6397	0.6397	1.0000	IRS
Ekwanda	47	0.5143	0.5235	0.9824	IRS

Appendix 2: Dispensaries Summary statistics

Facility Name	Facility	CRSTE	VRSTE	CRSTE/ VRSTE	Returns to scale
Gachika	1	0.5527	0.5582	0.9901	IRS
Gatuto	2	0.5194	0.5973	0.8696	DRS
Gathaithi	3	0.3185	0.3982	0.7998	DRS
Kirima	4	0.3127	0.3158	0.9901	IRS
Gakawa	5	0.6767	0.6856	0.9871	IRS
Junju	6	1.0000	1.0000	1.0000	_
Bofu	7	0.5355	0.6693	0.8000	DRS
Kizingitini	8	0.3453	0.3754	0.9199	IRS
Bokole	9	0.9826	0.9826	1.0000	_
Kighombo	10	0.2336	0.2397	0.9747	IRS
Meti	11	0.1458	0.1634	0.8925	IRS
Ena	12	0.4378	0.4422	0.9901	IRS
Badana	13	0.1531	0.1621	0.9442	IRS
Itoleka	14	1.0000	1.0000	1.0000	_
Katani	15	0.6398	0.8445	0.7576	IRS
Liani	16	1.0000	1.0000	1.0000	IRS
Kargi	17	0.4569	0.4589	0.9957	_
Gitura	18	1.0000	1.0000	1.0000	_
Gianchuku	19	0.3460	0.3467	0.9980	DRS
Pumwani	20	1.0000	1.0000	1.0000	IRS
Daley	21	0.5037	0.5037	1.0000	IRS

Guba	22	0.8251	0.8263	0.9986	IRS
Batalu	23	0.5666	0.5723	0.9901	DRS
Gongo	24	0.4770	0.4961	0.9615	IRS
Egotonto	25	0.8568	0.9853	0.8696	DRS
Miwani	26	0.3255	0.3417	0.9524	IRS
Angaga	27	0.2852	0.3337	0.8547	IRS
Ensakia	28	0.2804	0.3364	0.8333	DRS
Anyuongi	29	0.6930	0.8663	0.8000	DRS
Chesongo	30	0.1677	0.1928	0.8696	DRS
Belgut	31	1.0000	1.0000	1.0000	_
Anin	32	0.3409	0.3443	0.9901	IRS
Enkirgir	33	0.2205	0.2866	0.7692	IRS
Chebirbei	34	0.2287	0.2561	0.8929	IRS
Matanya	35	1.0000	1.0000	1.0000	_
Eburru	36	0.8612	0.9904	0.8696	DRS
Cheplengu	37	0.2447	0.3303	0.7407	IRS
Enoosupukia	38	1.0000	1.0000	1.0000	IRS
Ledero	39	0.4543	0.4543	1.0000	IRS
Goseta	40	0.6702	0.8177	0.8197	DRS
Nameyana	41	1.0000	1.0000	1.0000	IRS
Chepkemel	42	1.0000	1.0000	1.0000	IRS
Annet	43	0.7797	0.8577	0.9091	IRS
Siboti	44	1.0000	1.0000	1.0000	_
Budalangi	45	1.0000	1.0000	1.0000	_
Masaba	46	0.6548	0.7727	0.8475	DRS
Mutisinyi	47	0.6025	0.7230	0.8333	DRS

Appendix 3: Health centres inputs and Outputs used in the study for the DEA Model

	DMUs	**INPUTS**		**OUTPUTS**	
Code	**Health Centre**	**Medical personnel**	**Expenditure**	**Outpatient Visits**	**Immunization**
1	Githunguri	27	450,000	45,907	5,678
2	Kabare	341	450,000	34,641	7,645
3	Gatura	38	450,000	20,697	4,567
4	Kaimbaga	6	450,000	8,949	3,498
5	Bellevue	9	450,000	14,109	5,104
6	Gongoni	14	450,000	52,574	13,453
7	Shimba Hills	4	450,000	18,751	6,785
8	Kiunga	7	450,000	14,792	4,897
9	Kisimani	10	450,000	24,730	7,674
10	Bura	5	450,000	20,479	7,876
11	Garsen	9	450,000	39,810	10,768

12	Kanja	11	450,000	17,655	8,234
13	Kinna	7	450,000	17,058	4,567
14	Kamutei	5	450,000	16,238	6,231
15	Kaviani	9	450,000	25,681	10,123
16	Kathonzweni	12	450,000	33,777	15,234
17	Dabel	7	450,000	6,702	798
18	Akachiu	13	450,000	23,851	10,301
19	Mpukoni	16	450,000	22,724	7,653
20	Bahati	77	450,000	27,141	10,234
21	Kora kora	10	450,000	10,899	2,345
22	Banisa	9	450,000	11,132	2,345
23	Alimaow	5	450,000	8,493	1,754
24	Kitare	13	450,000	18,382	6,743
25	Iranda	13	450,000	17,432	3,478
26	Lumumba	15	450,000	24,696	9,276
27	Mariwa	32	450,000	14,229	5,456
28	Endiba	6	450,000	8,615	2,987
29	Gobei	4	450,000	13,971	4,876
30	Kituro	25	450,000	25,390	14,491
31	Bomet	10	450,000	17,686	6,451
32	Kapteren	27	450,000	27,503	11,395
33	Isinya	22	450,000	42,590	27,385
34	Ainamoi	7	450,000	15,020	7,386
35	Huruma	12	450,000	28,437	12,395
36	3KR	15	450,000	21,631	10,748
37	Kilibwoni	9	450,000	27,213	14,234
38	Olokurto	33	450,000	14,616	8,647
39	Kisima	33	450,000	18,458	10,328
40	Kwanza	30	450,000	18,669	9,476
41	Kerio	7	450,000	7,191	2,234
42	Chembulet	15	450,000	20,969	9,834
43	Alale	12	450,000	6,853	4,345
44	Bumula	22	450,000	36,510	25,621
45	Mtayos	17	450,000	47,807	28,392
46	Bukura	31	450,000	30,581	13,498
47	Ekwanda	16	450,000	23,264	10,231

Appendix 4: Dispensaries inputs and Outputs used in the study for the DEA Model

	DMUs	INPUTS		OUTPUTS	
Code	**Dispensary**	**Medical Personnel**	**Expenditure**	**Outpatient visits**	**Immunization**
1	Gachika	5	110,000	15,948	2,342
2	Gatuto	5	110,000	14,988	2,345
3	Gathaithi	24	27,500	9,190	1,673
4	Kirima	4	27,500	9,022	2,456
5	Gakawa	12	27,500	19,528	6,298
6	Junju	3	27,500	28,856	13,324
7	Bofu	4	27,500	15,451	7,128
8	Kizingitini	18	27,500	9,965	4,284
9	Bokole	20	27,500	28,354	11,947
10	Kighombo	4	27,500	6,226	3,113
11	Meti	3	27,500	3,797	1,943
12	Ena	5	27,500	12,633	5,231
13	Badana	5	27,500	2,164	987
14	Itoleka	3	27,500	15,308	2,211
15	Katani	3	27,500	7,400	3,625
16	Liani	2	27,500	14,438	5,275
17	Kargi	3	27,500	5,307	2,589
18	Gitura	7	27,500	17,316	7,231
19	Gianchuku	5	27,500	4,796	2,231
20	Pumwani	87	27,500	28,344	14,544
21	Daley	2	27,500	4,147	2,657
22	Guba	5	27,500	12,326	5,321
23	Batalu	4	27,500	7,373	3,432
24	Gongo	25	27,500	9,233	4,234
25	Egotonto	19	27,500	15,649	5,341
26	Miwani	8	27,500	4,709	2,345
27	Angaga	4	27,500	3,772	1,750
28	Ensakia	7	27,500	3,764	2,020
29	Anyuongi	6	27,500	12,657	4,069
30	Chesongo	5	27,500	2,757	1,208
31	Belgut	3	27,500	8,183	5,345
32	Anin	47	27,500	5,787	2,456
33	Enkirgir	3	27,500	1,804	967
34	Chebirbei	4	27,500	3,024	1,043
35	Matanya	5	27,500	18,264	7,205
36	Eburru	5	27,500	14,883	6,205
37	Cheplengu	7	27,500	4,196	1,567
38	Enoosupukia	2	27,500	239	132

39	Ledero	5	27,500	5,021	2,069
40	Goseta	11	27,500	15,429	6,430
41	Nameyana	3	27,500	3,010	2,090
42	Chepkemel	4	27,500	7,201	3,653
43	Annet	4	27,500	6,589	2,674
44	Siboti	5	27,500	15,906	4,409
45	Budalangi	11	27,500	23,020	10,294
46	Masaba	32	27,500	15,074	5,328
47	Mutisinyi	12	27,500	13,870	4,675

Appendix 5: Variables for the health centres regression

Facility Name	Facility Code	CRS DEA Scores	VRS DEA Scores	SE DEA Scores	Medical Personnel	Expenditure	Out Patients Visits	Immunizations
Githunguri	1	0.8732	0.8976	0.9728	27	450000	45907	5678
Kabare	2	0.6589	0.6625	0.9946	341	450000	34641	7645
Gatura	3	0.3937	0.3937	1.0000	38	450000	20697	4567
Kaimbaga	4	0.4068	0.4132	0.9845	6	450000	8949	3498
Bellevue	5	0.4740	0.4980	0.9518	9	450000	14109	5104
Gongoni	6	1.0000	1.0000	1.0000	14	450000	52574	13453
Shimba Hills	7	1.0000	1.0000	1.0000	4	450000	18751	6785
Kiunga	8	0.5253	0.5260	0.9987	7	450000	14792	4897
Kisimani	9	0.6788	0.6798	0.9985	10	450000	24730	7674
Bura	10	1.0000	1.0000	1.0000	5	450000	20479	7876
Garsen	11	1.0000	1.0000	1.0000	9	450000	39810	10768
Kanja	12	0.6953	0.6953	1.0000	11	450000	17655	8234
Kinna	13	0.8028	0.8053	0.9969	7	450000	17058	4567
Kamutei	14	1.0000	1.0000	1.0000	5	450000	16238	6231
Kaviani	15	0.9779	0.9927	0.9851	9	450000	25681	10123
Kathonzweni	16	1.0000	1.0000	1.0000	12	450000	33777	15234
Dabel	17	0.3154	0.4254	0.7414	7	450000	6702	798
Akachiu	18	0.7061	0.7445	0.9484	13	450000	23851	10301
Mpukoni	19	0.6728	0.6848	0.9825	16	450000	22724	7653
Bahati	20	0.8035	0.8132	0.9881	77	450000	27141	10234
Kora kora	21	0.3789	0.3789	1.0000	10	450000	10899	2345
Banisa	22	0.4239	0.4239	1.0000	9	450000	11132	2345
Alimaow	23	0.5230	0.5520	0.9475	5	450000	8493	1754
Kitare	24	0.5442	0.5567	0.9775	13	450000	18382	6743
Iranda	25	0.5839	0.5873	0.9942	13	450000	17432	3478
Lumumba	26	0.7556	0.7630	0.9903	15	450000	24696	9276
Mariwa	27	0.3341	0.3368	0.9920	32	450000	14229	5456
Endiba	28	0.4898	0.4898	1.0000	6	450000	8615	2987
Gobei	29	1.0000	1.0000	1.0000	4	450000	13971	4876

Kituro	30	0.5961	0.5984	0.9962	25	450000	25390	14491
Bomet	31	0.7126	0.7232	0.9853	10	450000	17686	6451
Kapteren	32	0.6458	0.6463	0.9992	27	450000	27503	11395
Isinya	33	1.0000	1.0000	1.0000	22	450000	42590	27385
Ainamoi	34	0.8561	0.8721	0.9817	7	450000	15020	7386
Huruma	35	1.0000	1.0000	1.0000	12	450000	28437	12395
3KR	36	0.6618	0.6632	0.9979	15	450000	21631	10748
Kilibwoni	37	1.0000	1.0000	1.0000	9	450000	27213	14234
Olokurto	38	0.3057	0.3142	0.9729	33	450000	14616	8647
Kisima	39	0.3861	0.3925	0.9837	33	450000	18458	10328
Kwanza	40	0.3905	0.3905	1.0000	30	450000	18669	9476
Kerio	41	1.0000	1.0000	1.0000	7	450000	7191	2234
Chembulet	42	0.4916	0.4946	0.9939	15	450000	20969	9834
Alale	43	0.2223	0.2243	0.9911	12	450000	6853	4345
Bumula	44	0.9024	0.9084	0.9934	22	450000	36510	25621
Mtayos	45	1.0000	1.0000	1.0000	17	450000	47807	28392
Bukura	46	0.6397	0.6397	1.0000	31	450000	30581	13498
Ekwanda	47	0.5143	0.5235	0.9824	16	450000	23264	10231

Appendix 6: Variables for the dispensaries regression

Facility Name	Facility Code	CRS DEA Scores	VRS DEA Scores	SE DEA Scores	Medical Personnel	Expenditure	Out Patients Visits	Immunizations
Gachika	1	0.5527	0.5582	0.9901	5	110000	15948	2342
Gatuto	2	0.5194	0.5973	0.8696	5	110000	14988	2345
Gathaithi	3	0.3185	0.3982	0.7998	24	110000	9190	1673
Kirima	4	0.3127	0.3158	0.9901	4	110000	9022	2456
Gakawa	5	0.6767	0.6856	0.9871	12	110000	19528	6298
Junju	6	1.0000	1.0000	1.0000	3	110000	28856	13324
Bofu	7	0.5355	0.6693	0.8000	4	110000	15451	7128
Kizingitini	8	0.3453	0.3754	0.9199	18	110000	9965	4284
Bokole	9	0.9826	0.9826	1.0000	20	110000	28354	11947
Kighombo	10	0.2336	0.2397	0.9747	4	110000	6226	3113
Meti	11	0.1458	0.1634	0.8925	3	110000	3797	1943
Ena	12	0.4378	0.4422	0.9901	5	110000	12633	5231
Badana	13	0.1531	0.1621	0.9442	5	110000	2164	987
Itoleka	14	1.0000	1.0000	1.0000	3	110000	15308	2211
Katani	15	0.6398	0.8445	0.7576	3	110000	7400	3625
Liani	16	1.0000	1.0000	1.0000	2	110000	14438	5275
Kargi	17	0.4569	0.4589	0.9957	3	110000	5307	2589
Gitura	18	1.0000	1.0000	1.0000	7	110000	17316	7231
Gianchuku	19	0.3460	0.3467	0.9980	5	110000	4796	2231

Pumwani	20	1.0000	1.0000	1.0000	87	110000	28344	14544
Daley	21	0.5037	0.5037	1.0000	2	110000	4147	2657
Guba	22	0.8251	0.8263	0.9986	5	110000	12326	5321
Batalu	23	0.5666	0.5723	0.9901	4	110000	7373	3432
Gongo	24	0.4770	0.4961	0.9615	25	110000	9233	4234
Egotonto	25	0.8568	0.9853	0.8696	19	110000	15649	5341
Miwani	26	0.3255	0.3417	0.9524	8	110000	4709	2345
Angaga	27	0.2852	0.3337	0.8547	4	110000	3772	1750
Ensakia	28	0.2804	0.3364	0.8333	7	110000	3764	2020
Anyuongi	29	0.6930	0.8663	0.8000	6	110000	12657	4069
Chesongo	30	0.1677	0.1928	0.8696	5	110000	2757	1208
Belgut	31	1.0000	1.0000	1.0000	3	110000	8183	5345
Anin	32	0.3409	0.3443	0.9901	47	110000	5787	2456
Enkirgir	33	0.2205	0.2866	0.7692	3	110000	1804	967
Chebirbei	34	0.2287	0.2561	0.8929	4	110000	3024	1043
Matanya	35	1.0000	1.0000	1.0000	5	110000	18264	7205
Eburru	36	0.8612	0.9904	0.8696	5	110000	14883	6205
Cheplengu	37	0.2447	0.3303	0.7407	7	110000	4196	1567
Enoosupukia	38	1.0000	1.0000	1.0000	2	110000	239	132
Ledero	39	0.4543	0.4543	1.0000	5	110000	5021	2069
Goseta	40	0.6702	0.8177	0.8197	11	110000	15429	6430
Nameyana	41	1.0000	1.0000	1.0000	3	110000	3010	2090
Chepkemel	42	1.0000	1.0000	1.0000	4	110000	7201	3653
Annet	43	0.7797	0.8577	0.9091	4	110000	6589	2674
Siboti	44	1.0000	1.0000	1.0000	5	110000	15906	4409
Budalangi	45	1.0000	1.0000	1.0000	11	110000	23020	10294
Masaba	46	0.6548	0.7727	0.8475	32	110000	15074	5328
Mutisinyi	47	0.6025	0.7230	0.8333	12	110000	13870	4675

Appendix 7: Distribution of Levels 2 & 3 facilities across the counties

COUNTY	DISPENSARIES	HEALTH CENTRES	TOTAL
Baringo	156	19	175
Bungoma	87	15	102
Bomet	102	19	121
Busia	52	13	65
Elgeyo Marakwet	91	21	112
Embu	81	13	94
Garissa	47	22	69
Homa bay	115	44	159
Isiolo	34	5	39

Kajiado	88	28	116
Kakamega	109	42	151
Kericho	150	14	164
Kiambu	146	43	189
Kilifi	93	15	108
Kirinyaga	71	17	88
Kisii	80	21	101
Kisumu	83	30	113
Kitui	241	25	266
Kwale	64	7	71
Laikipia	59	10	69
Lamu	22	5	27
Machakos	148	25	173
Makueni	132	23	155
Mandera	28	21	49
Marsabit	62	17	79
Meru	142	27	169
Migori	107	22	129
Mombasa	41	11	52
Murangá	109	17	126
Nairobi	179	92	271
Nakuru	155	44	199
Nandi	150	19	169
Narok	106	26	132
Nyamira	62	39	101
Nyandarua	60	16	76
Nyeri	125	24	149
Samburu	55	5	60
Siaya	97	39	136
Taita taveta	47	17	64
Tana River	48	5	53
Tharaka nithi	61	13	74
Trans Nzoia	52	9	61
Turkana	99	12	111
Uasin Gishu	101	26	127
Vihiga	30	20	50
Wajir	46	27	73
West Pokot	73	7	80
TOTAL			**5317**

Source: ***Ministry of public health and sanitation***