TECHNICAL AND SCALE EFFICIENCY OF HOSPITALS IN KISUMU COUNTY KENYA

JOAN W. A. OCHIEL

A RESEARCH PROJECT SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF A DEGREE IN MASTER OF BUSINESS ADMINISTRATION (OPERATIONS MANAGEMENT),
UNIVERSITY OF NAIROBI

2019

DECLARATION

I, JOAN WINNIE OCHIEL, solemnly declare that this is my original work and it has not been and shall not be presented in any other institution or University other than the University of Nairobi for examination.

Signed: _____ Date: _____

JOAN WINNIE OCHIEL

D61/7440/2017

School of Business

University of Nairobi

SUPERVISOR'S APPROVAL

I declare that this proposal has been presented with my approval as a university supervisor.

Signed: _____ Date: _____

MR. ERNEST AKELLO

School of Business

University of Nairobi

DEDICATION

Major dedication goes to Kisumu county health management board and other health facilities in Kenya, to my daughter Kue, my sister Yvonne and my parents Musa and Jenipher.

ACKNOWLEDGMENTS

First and foremost, I thank the all-time Deity who owns the power and grants life for having blessed my schooling days that am hereby finalizing my research studies. My best regards and cheer team is my wonderful family for having graced my academic life with utmost support in terms of moral and financial support.

I extend my sincere gratitude to my supervisors who indeed modeled my path in this academic endeavor, great thanks to Mr. Akello and Mr. Chirchir and other distinguished lectures for their professional unwavering support in the course of this research.

I owe a great deal of gratitude to my coworkers for their moral support and all my classmates that positively influenced my schooling life and continuously inspiring the wheels of life. May the Lord bless you all.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABREVIATIONS AND ACRONYMS

CRS: Constant Return to Scale

DEA: Data Envelopment Analysis

DMU: Decision Making Units

FP: Family Planning

HIV: Human Immunodeficiency Virus

MCH: Mother-child Health

OPD: Outpatient Department

PET: Public Expenditure Tracking Survey

STI: Sexually Transmitted Infections

SARAM: Service Availability and Readiness Assessment Mapping

SE: Scale Efficiency

UTI: Urinary Tract Infection

UHS: University Health Services

VRS: Varied Return to Scale

WHO: World Health Organization

ABSTRACT

This study sought to ascertain the technical and scale efficiency of hospitals in Kisumu County. More specifically, the study aimed towards two specific objectives: to analyze the technical and scale efficiency of public and private hospitals in Kisumu County for the years between 2014 and 2017 and to determine the factors influencing efficiencies of public and private health facilities in Kisumu County. Using a primary data collected through semi-structured interviews and questionnaires as well as the VRS-INPUT Oriented DEA model and CRS-Output oriented DEA model, the study findings shows that out of the 32 of hospitals in Kisumu County analyzed under the VRS-INPUT Oriented DEA model, 32.25 % of the hospitals were fully efficient with efficiency score of 100. Equally, the study established that 50 % of the hospitals selected in the study area were found to be efficient in their input use, while 50% were found to be operating inefficiently in output and input variables. For the second objectives, the study established that the number of delivery care, Number of women receiving postnatal care within 48 hours of childbirth (PNCs), the number of women with three prenatal examinations completed as well as the number of medical terminations of pregnancy (MPTs) were statistically significant in influencing the input oriented model. Equally, we also established that the number of delivery care, Number of women receiving postnatal care within 48 hours of childbirth (PNCs) as well as the number of women with three prenatal examinations completed as was statistically significant in influencing the output-oriented model. The study thus recommends that hospitals should maintain an appropriate size of delivery care in their hospitals to ensure that high number delivery care does not jeopardize their efficiency in their endeavors to optimize their efficiency. Equally, the management must always keep assessing the effects of delivery care on their efficiency to be able to take appropriate output efficiency decisions. Further research would be done to focus more on other alternative factors that affect efficiency of hospitals.

CHAPTER ONE: INTRODUCTION

1.1 Background of the study

Insufficient healthcare funding is a major problem in most Sub Saharan African Nations and Kenya is not an exception. Kenya's public health sector faces financial constraints and shortage of health work force in almost entire levels of care. This situation therefore explores an interest to find an effective use of existing financial and human resources for enhancing health services in the country. Evaluating the performance of health facilities can help decision makers make optimal use of available resources.

1.1.1 Technical Efficiency

Technical efficiency is a management issue where more results are needed for given level of resources. By providing the largest volume of productions, healthcare system is thus technically efficient by measure and considering the resources and technology at hand. The capability to create the largest possible variety of outputs that can secure the desired outcomes is thus technical efficiency. Health provision may under the same conditions, be described as technically efficient when the smallest factors of production are used with the constraints at hand and technology. Therefore, a technically efficient provider can proffer a selected scale of production using reduced inputs. Alternatively, higher level productions can be created with a given amount of inputs (Farell, 1957; Dario & Simar 2007).

1.1.2 Scale Efficiency

Measurement of scale performance is critical in addressing the issue of optimal production volume and managing reasonable distribution of resources that can improve/surge efficiency in hospitals (O'Donnell, Kristensen et al. 2008; Preyra, Pink, 2006; Nguyen, 2013; Nguyen et al., 2005). Scale efficiency is a deterministic factor in hospital performance considering the size and the nature of production process. In other studies, hospital size is a factor to reckon with considering the resources base investments than smaller hospitals that are less efficient scale wise (Cowing & Holtman, 1983).

Hospitals are multifaceted establishments, which can function from a smaller unit to a larger hospital (Weaver & Deolalikar, 2004). In addition, hospitals can be made more efficient is they adopt economies of scale in their operations in adopting latest technologies, efficient use of labor and other capital outlays in the production process that enhance growth capacity and reduction of wastes. In other words, scale efficiency is an instrument that helps upsurge the hospital efficiency besides is an essential tool for controlling and rationally allocating the most imperative economic resources and heath work force in the hospital (Asmild et al. 2013).

1.1.3 The Health Sector in Kenya

The structure of Kenyan healthcare sector consists of three systems, public's share being 45%, the non-governmental organization (NGO) 15% and the private sector 40%, that involves the offering of primary preventive measures and tertiary curative services. Kenyans have an elaborate constitution of 2010 that provides the framework that allows and pledges inclusive health rights for all her citizens as ascribed in Article 43 of the constitution. In order to actualize these rights, the County governments and the National government have structured responsibilities to enable them to attain this goal. This is well elaborated in the 4th Schedule of the constitution which permits direction regarding services to be offered either by the county or national government. Essential health service deliveries are a mandate to the county governments and the national government mandated to issues to do with management of referral hospitals, formulation of health policies, technical support to the counties.

The government owns most of the healthcare facilities in the country including two biggest regional referral hospitals (Kenyatta National Hospital (KNH) and Moi Teaching and Referral Hospital (MTRH)), county owned health facilities, health centers and dispensaries across the nation that offers holistic healthcare. By contrast, the private sector has a bigger share almost 100% of nursing homes and health clinics. According to the Kenyan statistics (2018), 6,394 Kenyan physicians practicing actively were listed. Of these, 2,591 were specialists. Out of a total of 7,333 there were 939 foreign doctors with temporary licenses. More than 5,000 health facilities in Kenya form the nationwide network for health services. Wanjau et al. (2012) from their studies assert that national referral hospitals provide specialized healthcare services that involve diagnostic and therapeutic services. These referral hospitals are mandated to provide

complex health services and usually requiring more complex technologies and highly skilled human resources for health.

Overall, a hospital is managed by a medical superintendent under the leadership of a management team comprised of administration, nursing, pharmacy, and other related health care professionals. Clinicians and nurses are the individuals responsible for various clinical service units who work without dedicated departmental administrators (English et al., 2009). They are typically expected to provide resources and advocate because of the implausible direct control of budget for any particular departmental budget. These persons not only supervise teams of frontline personnel, be it of medical or nursing staff, but also contribute to the provision of services. According to Argote (2000) asserts that by up surging hospital facilities in the country and having highly specialized human resources for health (doctors, nurses, administrators, and support staff) offers an optimal quality of healthcare to the people. The health sector is a high-regulatory sector, based on the latest diagnostic technologies and healthcare costs, which are typically borne by third parties, such as insurance companies or government programs. These factors require a quality management system that complies with external regulations and uses the latest technologies and knowledge for effective application.

1.2 Research Problem

Efficiency improvement should be seen as a strategy for mobilizing domestic resources and utilizing the available resources without waste to achieve the desired health sector goals. High inefficiencies in hospitals have hampered the government's initiatives to advance quality healthcare delivery. According to a study by Zere et al. (2015) in Namibia based on all 30 public sector hospitals. The study inputs were clustered as total number of beds, nursing work force, expenditures whereas outputs were total number of OPDs, and IP days. In the study, the outcome depicted that 62.7% to 74.3% was a range that illustrated the average technical efficiency and ICRs was the most desirable form of scale efficiency.

Studies done by Akazili, et al., (2013) in Ghana demonstrated that public health facilities are not maximizing healthcare outcomes from available resource endowments. The input variables used were total number of; support staff, clinicians, beds and cost of pharmaceuticals while the outputs total was number of; OPD visits, antenatal care clinic (ANC) attendance, safe deliveries,

child immunizations and family planning (FP) clinic visits. Results from 89 randomly selected health centers using DEA analysis showed that 58 (65%) were not efficient with an average technical efficiency score of 57% while 70 (79%) operated inefficiently with an average efficiency score of 86%. The study recommended performance targets for the inefficient facilities.

Locally, Kirigia et al. (2013) revealed inefficiencies in public hospitals. Among the 54 public hospitals analyzed using DEA approach, 14 (26%) technically were inefficient with an average technical efficiency score of 84% with standard deviation of 15.5% and 16 (29.6%) of the hospitals were found to be scale inefficient scoring a 90% average scale efficiency. The study provided magnitudes by which input could be reduced or output increased so as to make inefficient hospitals attain technical efficiency. The input variables were human resources for health (HRH) that includes; doctors, clinicians, pharmacists, dentists, nurses, administrative staff, technicians/technologists, supportive staff, health products and technologies (HPTs) that included; pharmaceuticals and non-pharmaceutical supplies and nutritional supplies, capital equipment's, vehicles and buildings. The intermediate output used includes; OPD, FP, special clinic and dental visits, maternity, pediatric and amenity ward admissions.

In this context, the study establishes the technical and scale efficiency of health facilities in Kisumu County that relates to provision of quality healthcare and their interrelations. This study will focus on a model that will comprise both government owned and private institutions from 2014 to 2017. The study pursues to respond to the following research questions, what are the technical and scale efficiency of both governments owned and private hospitals Kisumu County in the delivery of quality healthcare for the years between 2014 and 2017? And what are the factors influencing efficiencies of both public and private health facilities in Kisumu County?

1.3 Study Objectives

The broad objective of this study is to establish the technical and scale efficiency of hospitals in Kisumu County.

1.3.1 Specific Objectives

i. To analyze both the technical and scale efficiency of both public and private hospitals in Kisumu County in the delivery of quality healthcare for the years between 2014 and 2017
ii. To determine the factors influencing efficiencies of both public and private health facilities in Kisumu County

1.4 Value of the Study

Efficiency majorly is concerned about avoiding waste, be it waste of materials, energy, labor, money or time. The study outcomes will be gainful to the County Health Management Board (CHMB) and also relevant stakeholders in Kisumu County to allocate scarce health resources for maximum value and returns. The results will also be used for benchmarking purposes by the various health facilities. Outcomes of this research policy makers and the planners as well as identifying the causes of inefficiencies and taking the necessary action to remedy them.

The results of the study would be useful to the policymakers and hospital managers in coming up with the appropriate policies and intervention at the management level with the aim of ensuring efficient use of health care resources. This study has identified the DMUs with 'best practice.' In the context of Kisumu County Hospitals this study defines DMU as a large unit which comprises of sub-units, for example, medicine includes smaller units namely neurology, skin, special cardiac, general medicine, diabetes, chest and tuberculosis. Other organizations will also benefit from this study as they benchmark from the best practice solutions available to improve their service delivery. An improved organization is an efficient entity that attracts customers and makes more sales thus becomes more profitable with time and enhances sustainability in the business industry.

The study will be gainful in aiding academic quest of students and also offering a platform for further research in the same field to unearth more solutions required to offer the best practice in a more efficient and cost-effective way.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This section gives both literatures that encompass the efficiency of health care facilities and programs on theoretical and empirical outlook. Process efficiency affects cost of ownership and felt by the external customers, internally the processing times, non-value-added costs; quality costs and resource utilization per unit of output are imperative measures (Zaheer, Arshad & Rehman, 2008).

2.2 Theoretical Literature

Theoretical literature used to explain this study is majorly the, Theory of Constraints and The Scientific Management Theory as exemplified below.

2.2.1 Theory of Constraints (TOC)

Theory of constraints (TOC) illustrates that "the constraints or bottlenecks determines the output of a system." Goldratt (1990) asserts that by identifying and improving the constraint is the deterministic factor in broadening the output. As important as the table of contents may be for improving process flows, its impact on the field is far-reaching, as bottlenecks can be understood in one process and these bottlenecks can be better managed to ensure efficient process flows.

Production efficiencies are affected by bottlenecks and have a lasting effect on the process flow. This follows that process stages lag behind because they do not get enough inputs following bottlenecks in the preceding stages cannot work in their full capacity. The steps leading up to the bottleneck should slow down production as subsequent stages cannot manage capacity. Identifying by looking keenly every production stage of the process will produce possible bottlenecks in a sequential way. A solution can be achieved by regulating production level in the order in which it was identified. This can be accomplished by fitting more efficient equipment or occasionally by surging the workload requirements.

2.2.2 Scientific Management Theory

Frederick Taylor's scientific management theory, also referred to as classical management theory, is another theory that emphasizes efficiency, though it produces more efficient workforce and aims to provide the workers with the tools they need to improve their efficiency and performance to maximize. In general, a business process is considered efficient if there is no waste, and an organization with processes that are full of waste is considered inefficient because the efficiency is used to refer to the business processes in an organization (Berber, 2013).

Scientific management practices are the linchpin that has bridged the gap that existed for years and brought about collaboration between employers and their employees in the working environment. These practices brought about teamwork among players that made it easier to systematically identify problems and their solutions making working process seamlessly. Scientific management practices have made tremendous leadership skills in areas of systemic planning, selection and training procedures and provided opportunities to explore more profitable ventures in the continuity business going concerns (Berber, 2013).

2.3 Efficiency Concepts

According to Skaggs (1996), economic efficiency is understood as the best possible use of a specific price or the minimization of the price of a particular advantage. In addition, they argue that economic efficiency includes both technical efficiency, which is an efficiency without waste, and the allocative efficiency that in this setting means the use of inputs from the health system within Decision Management Unit (DMU) or a within the health facility is described as minimizing production costs at given input prices (Coelli et al. 2005). Salvatore (2008) argued that the technical efficiency describes the generation of the optimal number of accessible and affordable outcomes from the inputs incurred by a health conscious DMU. As an alternative, it is often mentioned that technical efficiency is to be realized with lean health resources inputs. This encompasses human resources for health, health technologies and capital investments and by extension the community resources.

The subdivisions of the decision units comprise of pure technical and scale efficiency. By delineation, pure technical efficiency is the efficiency that does not deviate from optimal scales as placed by DMU. Whereas it is claimed that a unit is scaling efficient once its operational size is in perfect order, changes in its size can make the unit less efficient (Fried et al., 1993). Scaling efficiency is analyzed by comparing two completely different outputs in the Data Envelopment Analysis (DEA): Use of a postulation of a constant scale return, while the opposite uses the varied scale return. This can categorically express whether or not a company is operating at its "optimal size". If this is not the case, more comparisons is done of DEA results with surging or diminishing economies of scale can verify that the company is "too big" or "too small" (Bogetoft & Otto, 2010).

2.3.1 Efficiency Analysis

Efficiency is defined broadly by the Institute of Medicine (IOM), 2001, as the preventive model of wastes, these includes wastes due to deliveries, wastes incurred due to obsolete equipment's, wastes from unproductive ideas and energy. Measuring the efficiency of healthcare providers and systems is driven by rising aid costs, which create tremendous pressure and questions about the efficiency and methods that are often used to evaluate and improve them (Cassel & Brennan 2007). William (1988) asserts that resources for health enable clients to achieve value for their money. Resources such as labor, capital and equipment's and their costs have a direct relationship with efficiency. For instance, total count of patients treated and the summed waiting times etc. and the outcomes that defines quality life years QALY's and Life Years Saved.

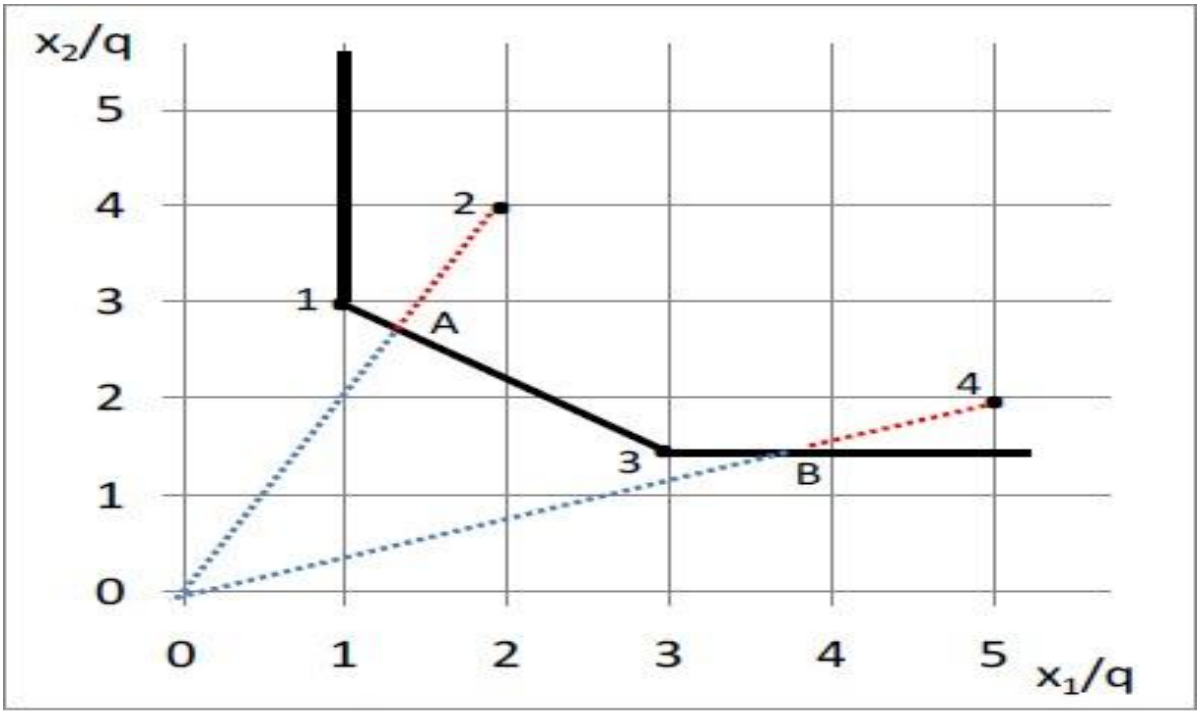
McGlynn et al., (2008) created a three level of efficiencies measures that illustrate a systematic review of an abstract situation. Level one; for the perspective, a specific identification of the company is required, which evaluates the efficiency, the company that is rated, and the objective of the rating. Each of these three elements of perspective can be critical in keeping each entity with a completely different goal. Stage two includes the outputs; where those of interest should be known and ways to measure how they are measured. The results are often characterized by health services that affect service times, medication and costs, and may even be cited as examples of health outcomes such as avoidable maternal deaths, as a clinical outcome in known and supervised malaria cases. Stage three are the inputs, this classifies the inputs that are used to

yield the desired results. Examples include the distribution of doctors and nurses at every process, capacity and capital resources

Charnes et al., (1978) assets that in all interval data studies, researchers limit the discussion to either overall efficiency, as measured by the CCR model and also measures of technical efficiency by the Banker, Charnes & Cooper (BCC Model), of 1984 will give a solution to whichever linear programming technique. However, little is understood and has not been measured on the efficiency of scale which is obtained as the ratio of CCR efficiency to BCC efficiency. It is obvious that efficiency is never absolute. Instead, it is always rated in as per the criterion set. Cooper et al., (2011) described relative efficiency that a DMU is fully efficient with the available evidence and not merely the overall performance of DMU's. It further notes that improving the input output can be made necessary without deteriorating other inputs and outputs.

For instance, a company that employs two inputs (X1 and X2) in the determination of production functions in the generation Y outputs. An organization can realize maximum performance as illustrated using the diagram below with combined inputs of x1 and x2. The points 1 and 3 are technically efficient points which are very close to the origin and produces unit outputs at lower inputs. Efficiency limits is illustrated by a straight line between the two points and a parallel to the x2 of axis and x2 axis will produce efficient boundaries as illustrated in figure 2.1

Figure 2.3 Efficiency frontier input-output map



Source: Researcher (2019)

2.3.2 Efficiency Measurement

Efficiency can be measured using different techniques; this study captures the Data Envelopment Analysis (DEA) as the preferred technique in this study but also other measurement models like Queuing Model, Stochastic Frontier Analysis etc.

2.3.3 Data Envelopment Analysis (DEA)

DEA is the most extensively used quantitative technique in non-parametric approaches that approximates the efficiency of countless companies in multiple sectors. This system primarily estimates the ratio of input and output parameters that offers success efficiency. It is an implicit approach and therefore the result is that the efficiency of doing business. This result provides the opportunity to demonstrate the pros and cons of doing business and processes, to meet business requirements and to identify ways to advance current work processes based on the idea of efficiency quantification (Gladovic, 2012).

In the DEA there is a tendency to use the idea of a "reference sentence" that is useful for tracking and is the most effective unit of production with which all other observations can be compared. The DEA methodology is a pragmatic approach that enmeshes the DMU intertwined the idea of technical efficiency taking into account the prevailing technology from a given combination of inputs, the best level of expenditure to achieve a certain output level, or, alternatively, to use the least possible amount of inputs to get a particular output. Consequently, the DEA approach offers direction on how to brand the inefficient production units efficient majorly using the reference group idea for efficient decision-making units that usually perform similar services (Toma et al., 2017).

Othman, (2010) asserts that DEA analysis is incomparable to theoretical maximum requirements. A representation of set of perspectives is needed in Constant Return to Scale (CRS) adoption in comparison to Variable Return to Scale and thus not. CRS adoption will imply a long-term visualization in measure of efficiency for the radial distance of a business to its limit. Additionally, the anticipated DEA model characterizes the Variable Return to Scales (VRS) theory known as DEA-BCC (Banker, Charnes & Cooper, 1984). Besides the methodology used in classifying efficient units in data envelope analysis are other important models such as the Assurance Region DEA model developed by Thompson et al., (1986) and the Super Efficiency Model developed by Andersen and Petersen, (1993).

2.3.4 Factors Influencing Efficiency

Due to financial constrains facing most hospital operations, value-based purchasing is the only option that will be able to procure the desired quality and cost-effective materials that can enhance optimal efficiency. In this respect, it is imperative to understand the causes of operational costs in the hospital; this will proffer a lucid structure for policy makers and health leaders to efficiently struck management options. Nevertheless, in the bide to improve hospital efficiency, measures such as reducing costs or up surging production is only relevant if quality is maintained. According to Zinn and Flood (2009), argues that limited hospital efficiency studies are responsible for quality compromises and that there is need to maintain quality regardless of cost reduction which can never be urgent or complex in the context. By use of hospital data to determine efficiency levels have offered a great opportunity to improve the validity and

reliability. Medicare and Medicaid Service Center (MMSC) have offered a modeling platform in accounting for patient outcomes that have produced usable material for determining disease predictors and management for improving hospital efficiency.

Preceding studies have pointed out that certain hospital features such as; profit-making (PF), the size and academic institutions have a different measure in hospital (Valdmanis, Rosko, Mutter, 2008). It emerged that academic/teaching hospital institutions have been connected to quality and efficiency. Considering the Effectiveness X and Ownership Theory suggest that internal profitability pressures may encourage profit making hospitals to operate more efficiently than public/government owned hospitals. On the other hand, some hospitals/facilities may discretely choose patients that are easier to treat and refer those that require intense Medicare to government owned hospitals. According to Rosko et al., (2008), teaching hospitals are generally less efficient compared to non-teaching hospitals, considering that teaching facilities are kin to features such as research and education which may hamper their full productivity in efficiently.

Other notable influencing factors are the hospital organizational behavior. These factors are subject to relationships that exist between the hospital and physicians may be considered. Hospital administrations have working agreements with their physicians that is integrated to offer best working conditions to enhance productivity and optimal patient outcomes. These contract agreements are integrated to offer a wide range of models that allows accommodative working practices. Integrative measures allow hospital to control costs, improve quality, and improve market share increase patient satisfaction and achieving organizational goals. In respect to the aforementioned, most hospital operations have adopted strict guidelines that warrant highest level of integrations (Rosto et al., 2008).

2.4 Empirical Literature

Study reviews by Joses and Eyob (2013), reported conclusions got from the initial stages of their analysis, 45 out of 70 hospitals were scaled efficiently in consideration of their scales of return were technically efficient in their variable scale of measure. In a subsumed calculation, they establish that inefficient hospitals surged day case visits by 6.08% and discharge from the hospitals by 2.45%. It emerged that the average inpatient duration of stay in the clinic and the ratio of inpatient visits to outpatient visits was found to be largely associated with the

inefficiencies in the hospital from the second stage analysis. The study showed that the data collected in Eritrea hospitals would be used to identify relatively inefficient hospitals and sources of their inefficiencies.

Also a study review by Mujasi, Asbuy & Junoy, (2016) about how successful reference hospitals are in Uganda, it turned out that hospitals suboptimal in their technical efficiency could be improved by surging the day care count appointments and days of hospitalization in this case maintaining overall count of input data. In the same breath, significance performance would be achieved if human resources for health and surplus health technologies are distributed to other levels of healthcare without necessarily alternating overall.

Other studies at the health center in Veneto, Italy, stated that majority of the hospitals in Veneto were congested in relation to the starting level. This was a problem of inefficiency of scale, which is the first cause of low overall productivity, mainly characterized by private hospitals (about 80% of the total number of private DMUs: 14 for-profit and five non-profit), while only 39% of public hospitals (23 DMU) shows a size below optimal. This result points out to Veneto special private hospital function in the healthcare system (Vincenzo & Dino, 2006)

In one of the studies conducted in Indonesia on hospital performance, it was emerged that overall efficiency turned out to be better after the implementation of lean hospital management (Heri, 2011). In a study conducted in Germany on the impact of property on hospital performance, outcomes presented more efficiency in government owned facilities compared to those owned by other forms; in particular individual or private owned property was associated with lower productivity. Even after a series of sensitivity checks, key findings remained unchanged. The outcomes inferred that private profit-oriented clinics put more emphasis on profits (i.e. increased priced price index for every case to generate more revenues), unlike government owned clinics that have financial constraints, put more emphasis primarily on the efficiency of outlays. The results also illustrated a significant inclined positive association that exists between the size of the hospital and productivity, also it is established that negative competition piles pressure which significantly negatively impact on the performance of clinics functions (Tiemann and Schregogg, 2008).

In an article that tried to apply the super-effectiveness of the DEA model in the results of Ugandan hospitals done by Yawe (2010), pointed the availability of various notches of technical inefficiency and scale in Ugandan health facilities. With the super-performance model, it is possible to rank efficient units.

Locally studies done by Kirigia et al., (2002) established that only 26% of government owned hospitals were considered technically ineffective when they did technical evaluation of government owned health facilities. The study then identified ineffective hospitals and provided them with the size of certain reduction in outlays or increase in production necessary to achieve technical efficiency. Kirigia et al., (2004) also undertook another study to determine effectiveness of government's owned health centers and based on their findings concluded that 44% of public health centers operate inefficiently.

Studies by Afonso and Aubyn (2005) compared effectiveness of health facilities in the nominated nations of the Organization for Economic Cooperation and Development (OECD) in 2000 and 2003, applied nonparametric approaches and employed human resources for health and health technologies as input indicators, while output indicators are life expectancy, and the survival rate of infants, the authors calculated average performance results for countries in a scale of 0.82 (DEA) to 0.98, Free Disposal Hull (FDH); Korea, Japan and Sweden were considered majorly economical of these countries. Studies by Grosskopf, Self & Zaim (2006) that aimed at measuring the performance indicators of healthcare facilities in 143 countries at the national level, was performed using DEA and a completely dissimilar set of indicators both inputs and outputs and results composed a world health report. In their report, concluded that industrialized nations have high performance results than the less industrialized nations. In addition, they compared the countries' performance over the thirteen years from 1977 to 1990, which showed that the improvement in productivity was also diversified depending on the development of the countries.

2.5 Summary of Literature Review

The thought about the effectiveness of the healthcare industries and the associated problems that include price efficiency and the value of money are several major important dimensions of healthcare efficiency. The literature explicates ideas seeking to apprehend the level to which

inputs to the healthcare system, in form of expenses and alternative resources, are used to safeguard valuable healthcare system objectives. The pursuit of efficiency, according to the majority of commentators, would be consistent with the fact that efficiency should be the main goal of decision-makers and managers, and for this purpose better methodologies for measuring and understanding productivity are desperately required. Cylus, Papanicolas & Smith (2016) stated that inefficient use of the resources of the healthcare system will cause serious problems and thus harm social solidarity, efficiency of the healthcare system and prosperity. Table 2.1 shows a summary of several studies that have been conducted on the measurement of hospital performance both globally and locally, as well as input and output data that were used in each study.

Table 2.5 Summary of Literature Review

Author	Input	Output	Findings
Mujasi, Asbu &Junoy (2016)	• Medical staff • Hospital beds	• outpatient visits • inpatient days	Hospitals could be made more efficient by increasing OPD visits and IP stays without altering the patients. At the same time, efficiency can be improved when surplus staff and beds are transferred to other levels of care without alternating no of outcomes.
Tiemann& Schregogg (2008)	• Hospital suppliers • Clinical staff • Nursing staff • Medical technical staff	• In patient • Mortality rate	Hospital performance, results showed that public facilities were more efficient compared to those owned by other forms; in particular individual or private owned property was associated with lower productivity, since they focus so much on profit.
Vincenzo&Dino (2006)	• Doctors count • Nurses count • Support staff count • Hospital bed count	• Inpatient • Count of treatment offered by emergency services	Low efficiency points are due to external factors not fully controlled by hospital management

Afonso & Auby (2005)	• Human resources for health • Health technologies	• Index of infant survival rates • Life expectancy	The highest efficiency rates were achieved by quasi-government hospitals, followed by public hospitals, mission hospitals and eventually private hospitals. Public hospitals were inefficient and had the lowest average technical efficiency.
Kirigia,Ali & Sambo,(2002)	• Medical Doctors • Clinical staff • Nursing Staff • Administrative staff • Technologists • Drugs • Food ratio • Beds	• OPD appointments • IP admission • Paediatric admission • Maternity ward admissions • Special Clinics, Dental, MCH, FP visits	Technical Inefficiency was drawn from 26% of the public hospitals. The technical efficiency was accorded by magnitudes of specific input reductions and or by increasing output majorly in inefficient hospitals.

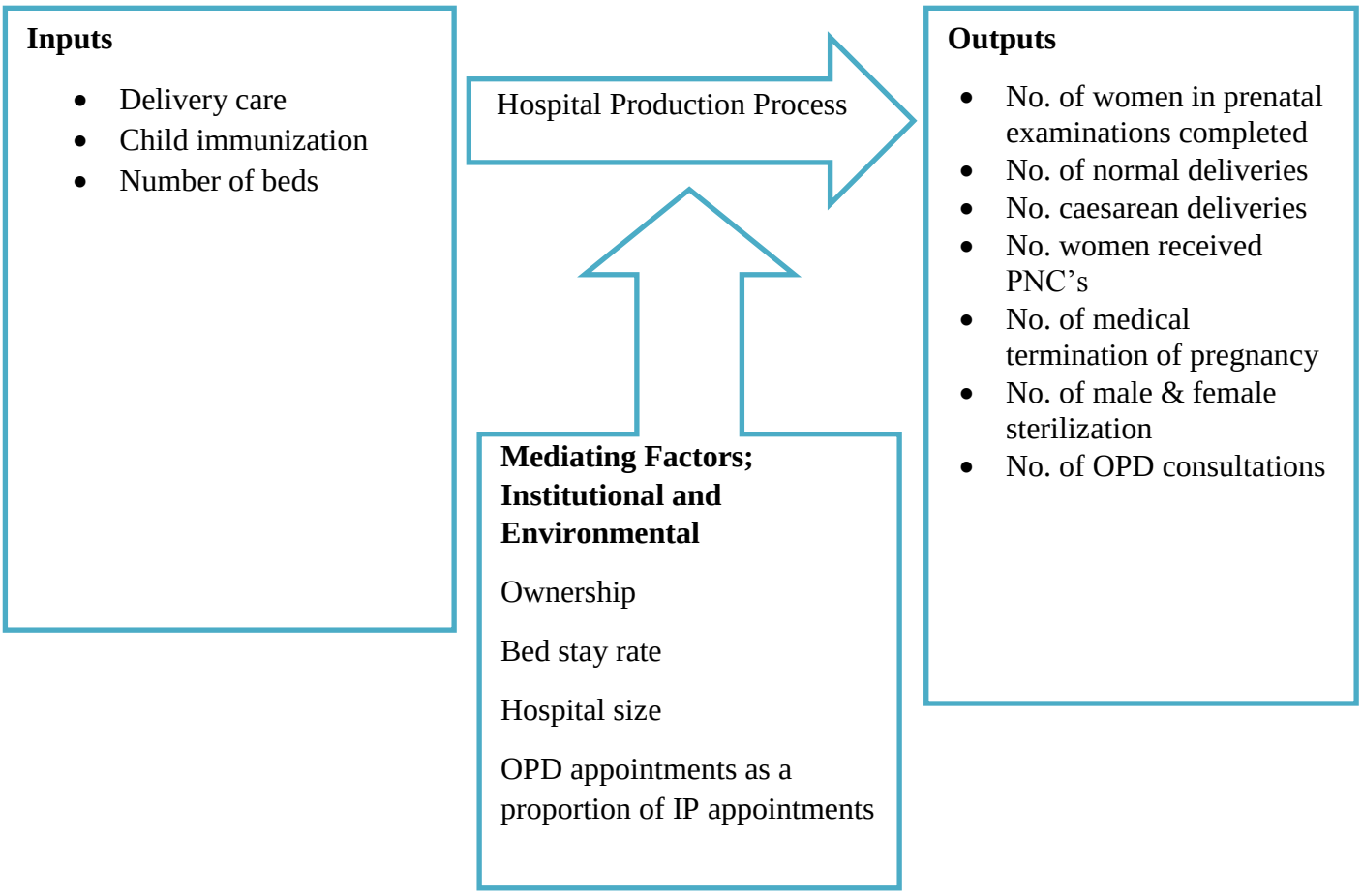
Source: Author (2019)

2.6 The Conceptual Framework

Health facilities transform various health resource inputs through a stream of production process to a number of desirable health outputs/ outcomes. These inputs are in particular labor and capital investments that require skillful combinations to produce results. The end results/ outcomes of a medical process may have a marginal adjustment in ones status of health and it is very difficult to measure using most data sets available. In many cases, intermediate outcomes that results from incidents of medicare such as the quantity of surgeries performed and OPD appointments are summed as outcomes. The health production process is also influenced by internal and external factors that contribute immensely to its efficiency levels (Coelli, Prasada, O'Donnell and Battese, 2005). These factors are often seen by hospital leaders as uncontrolled. Theoretically, the factors are determined by the health seeking behavior and systemic process that may directly affect process efficiency (Coelli et al., 2005).

DEA is a vital econometric analytical tool that enables health facilities to analyze chosen input and output variables. The health consumption is a continuous process that needs investments by health facilities that enable transformation of inputs into outputs. The cost of health is widening in many societies and being cognizant of the optimal usage of resources can reduce wastes in the health production. Key cost imperative measures are on labor, materials and capital investments. The end result of health manufacturing process improves the health of the population. Nevertheless, the complexity associated with this sort of analysis and data, is that it is difficult to estimate the improvement of population health as attributable to healthcare and this gives a leeway for intermediate outputs as a preferred choice.

Figure 2.6 Conceptual Frameworks



Source: Researcher (2019)

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

This part gives the methods used to achieve the study objectives. Herein, the research design, variable typology and definitions as well as the sampling techniques used are presented.

3.2 Research Design

A research design is a description of how the study will be carried out or simply a layout of the study (Sekaran, 2006; Downward & Mearman, 2006). In this regard, our study adopted a descriptive quantitative approach. The approach was adopted due to the fact that it helps in the collection of quantitative data about the study (Cooper & Schindler, 2000). Khan (2008) recommends descriptive research for its potential to establish factors related with certain occurrences, effects or conditions or sorts of behaviour. Polit and Beck (2013) states that, in a descriptive study, researchers take a look at, count, delineate, and classify.

3.3 Research Site

The study site was one Kenyan Counties (Kisumu County). The choice was mainly motivated by the fact that the county has a large population (968,909 according to 2009 census demographic figures) and relatively has a large area than any county in Nyanza region (20,859 km^2). The healthcare in this county is provided with the aid of numerous personal or authorities-funded establishments. The most important health amenities within the county are Jaramogi Oginga Odinga that is a Coaching and Referral Hospital (popularly known as Russia), the Kisumu county Hospital and the Aga Khan Kisumu Hospital, Jarallam Hospital, Kisumu Specialists Hospital are all placed in Kisumu Central Business District (CBD).

3.4 Target Population

The study's target population included all the hospitals in Kisumu County. On average, there is one referral hospital, 5 County referral hospital, 14 sub-county hospitals, 74 dispensaries and 18 health centers in the county. In total, the study targets 112 hospitals in Kisumu County.

3.5 Sampling technique

This is a system that draws conclusions grounded on measurements of elements of the targeted population (Cooper & Schindler, 2003; Zikmund et al., 2010). In our study, the sampling frame and unit for this study are the referral hospitals, sub-county hospitals, outpatient clinics and health centers in Kisumu County. We then used the proportionately stratified sampling technique whereby the study population was divided into referral, County, Sub-county, dispensaries and Health centers strata.

3.6 Sample Size

The study adopted the following method to calculate the sample size (Creative Research Systems, 2012).

$$Sample\ Size = \frac{\frac{Z^2\ X\ P(1-P)}{e^2}}{1 + \left(\frac{Z^2\ X\ P(1-P)}{e^2 N}\right)} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 1$$

Where the Z-score (Z) used is 1.96, the margin of error (e), 0.05, the distribution (P) is 0.5, and the population size (N). Given the Population size (N) as 112,

$$Sample\ Size = \frac{\frac{1.96^2\ X\ 0.5(1-0.5)}{0.05^2}}{1 + \left(\frac{1.96^2\ X\ P(1-0.5)}{0.05^2 X 112}\right)} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 2$$

n= 86

3.7 Data collection

Given the unavailability of some input variables of hospitals in the public domain, our study utilized primary data collection criteria. According to Andre (2004), primary data collection is unavoidable when information is unavailable and forms a reliable component for scientific cause when well structured. In this regard, this study made use of closed-ended questions mainly due to cost minimization and time saving.

3.8 Data Collection Instruments

3.8.1 Validity Test

This is the degree to which the sample check item symbolizes the content fabric is designed to measure (Somekhand, 2005). In our study, we checked for the validity through a pilot questionnaire on few selected Sub-county hospitals.

3.8.2 Reliability Test

According to Bryman (2004), reliability test refers to the "consistency of a degree of a concept" similar to Bells (2003) and Eriksson et al (2007), the test fulfils the logic conclusion of generalizing from the study findings. To do this, a Cronbach Alpha was used to test the reliability of questions (Sekeran, 2003).

3.9 Data Analysis

To estimate the performance results, the study applied the wording Banker, Charnes and Cooper (BCC) model DEA. The selection of the BCC approach was partly since each of our variables was supported on indicators which the study was trying to consider economies of scale. Additionally, as in all other DEA models, the BCC model supports multiple inputs and outputs, which is especially helpful in advanced areas such as healthcare systems. Algebraically; this is often achieved with the assistance of the succeeding applied math model:

$$(1)\ Max\left\{ e_0^e = \frac{\sum_i \mu_i y_{i0}}{\sum_j v_j x_{j0}} \right\}$$

$$Subject\ to:$$

$$(2)\ \frac{\sum_i \mu_i y_{ik}}{\sum_j v_j x_{jk}} \leq 1\ for\ all\ DMUs\ k=1,2,....,n$$

$$(3)\quad \mu_i \geq 0$$

$$(4)\quad v_j \geq 0$$

Where the symbols are explained in the table 3.1

symbol	***Explanation***
θ_0	Is the efficiency score of the DMU being analyzed
n	***Is the*** number of DMUs to be used;
I	**Is the** total number of outputs;
J	**Is the** total number of inputs;
Y_k	***Can assume*** y_{1k}, y_{2k}……and is the variable outputs for DMU k
y_{ik}	**Is the** value of output i for DMU k;
X_k	***Can assume*** x_{1k}, x_{2k}..., xjk…, and is the variable inputs for DMU k
x_{ik}	**Is the** value of input j for DMU k;
μ **and** ν	variable multipliers for Yk and $\mathbf{X_k}$ **respectively**

Source: Author (2019)

In modeling health service output, the study used a total of three input variables and seven output variables. The input variables for every hospital were: (1) child immunization; (2) Delivery care and (3) Number of beds available. The variable number of beds is enclosed as a proxy for inflows of capital. The variables considered as outputs included: (1) women receiving 3 prenatal examinations; (2) number of deliveries; (3) number of deliveries per caesarean section; (4) number of women receiving postnatal care in a span of 48 hours of childbirth (PNCs); (5) number of medical terminations of pregnancy (MPTs); (6) number of male and female sterilizations; and 7) number of outpatient consultations (OPD).

The choice of these input and output data was based on various studies of the effectiveness of healthcare in hospitals (Kirigia et al., 2004, 2002, Mungono, 2015, Yawe, 2010). The test used a two-step data analysis. The basic stage was the data envelope analysis (DEA), which was used to calculate performance results, i.e. CRS, VRS and SE for hospitals. While the second stage used e both the Ordinal Least-Squared (OLS) methodology in which performance results (CRS, VRS and SE) obtained in the initial stage will be analyzed by recording and regressing performance results in relation to management practices; and additionally, in the censored regression methodology (Tobit model), in which the results of DEA effectiveness (CRS, VRS and SE) was reduced in relation to the efficiency determinants using the Tobit method. In order to estimate performance, the encoded data is analyzed using the data envelope analysis (DEAP) program, while in the case of STATA regression analysis.

CHAPTER FOUR: DATA ANALYSIS, RESULTS AND DISCUSSION

4.1 Introduction

In this section, the results from the empirical estimation and their interpretations are presented. The section begins by presenting the descriptive statistics, Normality test, input and output efficiency models and concludes the with the regression model for the determinants of efficiency. Key to note is that the study utilized a cross-sectional research design to collect the data used to estimate hospital efficiency levels in Kisumu County. The data was collected from 32 hospital managers, one per hospital.

4.2 Descriptive statistics

To ascertain the nature of data used in our estimation, we undertook a descriptive statistic in which the minimum, the mean, standard deviation, and the maximum values were computed. Table 4.1 present general characteristics of the sample hospitals

Table 4.2 Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
beds	32	73.46875	122.6456	3	565
immunization	32	130.5	125.7976	16	500
delivery	32	12.5	16.74862	1	89
prenatal	32	1.34375	1.515711	0	6
deltwo	32	154.5938	144.6651	11	900
delcsec	32	4.09375	3.33466	0	17
postnatal	32	8.53125	9.827494	2	50
mpt	32	38.71875	18.47795	4	76
steralizat~n	32	102.3438	130.1333	15	500
opd	32	326.6875	200.2834	146	1015

Source: Author (2019)

As can be seen from Table 2, on average, each hospital had 74 beds while some hospitals had as little as 3 beds and others as many as 565 beds between the periods under study (2014-2017). The study further established that on average, child immunization stood approximately at 131 with the hospital that had the least number of child immunization in the study period standing at 16 while that with maximum number of child immunization reaching at 500 children. Another important statistic is the number of delivery care, which on average was approximately 13 delivery cares with the hospital with least number of delivery cares recording just one delivery while the hospital with largest delivery recording 89 deliveries with the period 2014-2019.

We also observed that the minimum and maximum Number of women in prenatal examinations completed stood at 0 and 6 respectively while on average; it was one mother per hospital in the period under study. Equally, we further established that the number of deliveries per caesarean section was on average 4 with a standard deviation of 3 with some hospitals recording as little as zero while others recording and many as 17 between 2014 and 2017. Lastly, we observed that number of outpatient consultations (OPD) was on average 327 with the least hospital recording 146 while the highest hospital recording 1015 OPDs. (See Table 4.2)

4.3 Normality Test

Test for normal distribution was carried out using Shapiro-Wilk Approach. The study results were tested at 5% significance level using the Shapiro-Wilk Approach. The smaller value of t less than 0.05 signified non normality while values greater than 0.05 signified normality. The results are presented in the table 4.2.

Table 4.3 Normality Test

Variable	Obs	W	V	z	Prob>z
beds	32	0.52494	15.847	5.736	0.00000
immunization	32	0.75295	8.241	4.379	0.00001
delivery	32	0.57135	14.299	5.522	0.00000
prenatal	32	0.85361	4.883	3.292	0.00050
deltwo	32	0.43996	18.682	6.078	0.00000
delcsec	32	0.85554	4.819	3.265	0.00055
postnatal	32	0.55362	14.890	5.607	0.00000
mpt	32	0.96883	1.040	0.081	0.46778
steralizat~n	32	0.63548	12.159	5.186	0.00000
opd	32	0.74263	8.585	4.463	0.00000

Source: Author (2019)

The test is against the null hypothesis of normality. The results revealed that all the variables in our data set were non-normal except the number of medically terminated of pregnancies (MPTs).

4.4 DEA Results of Input-orientated and Output-oriented Models

The first objectives aimed at analysing the hospitals in Kisumu County using the DEA model using the three inputs and seven outputs mentioned in the preceding section. The second objective which aimed at establishing the factors influencing efficiencies of both public and private health facilities in Kisumu County was achieved using CRS-OUTPUT and VRS-INPUT oriented models. The former calculates an efficiency score called constant returns to scale technical efficiency while the latter assumes variable returns to scale technology. The result for the DEA regression result for both models is displayed in Table 4.3

Table 4.3 DEA Results of Input-orientated and Output-oriented Models

DMU	CRS_TE	VRS_TE	NIRS_TE	SCALE	RTS	Rank
DMU1	0.444444	0.444444	0.580425	1.000000	0.000000	25
DMU2	0.680547	0.769972	1.000000	0.883859	-1.000000	19
DMU3	1.000000	1.000000	1.000000	1.000000	0.000000	1
DMU4	1.000000	1.000000	1.000000	1.000000	0.000000	1
DMU5	0.470509	0.580247	1.000000	0.810877	1.000000	23
DMU6	0.318086	0.350627	1.000000	0.907193	-1.000000	31
DMU7	1.000000	1.000000	1.000000	1.000000	0.000000	1
DMU8	0.762222	0.942296	1.000000	0.808899	-1.000000	17
DMU9	0.414611	1.000000	1.000000	0.414611	-1.000000	1
DMU10	0.925270	1.000000	1.000000	0.925270	-1.000000	1
DMU11	0.538070	0.595000	1.000000	0.904320	1.000000	22
DMU12	0.615233	1.000000	1.000000	0.615233	-1.000000	1
DMU13	1.000000	1.000000	1.000000	1.000000	0.000000	1
DMU14	1.000000	1.000000	1.000000	1.000000	0.000000	1
DMU15	0.657522	0.666824	1.000000	0.986050	1.000000	21
DMU16	0.526923	0.675840	0.691968	0.779657	-1.000000	20
DMU17	1.000000	1.000000	1.000000	1.000000	0.000000	1
DMU18	0.637681	1.000000	1.000000	0.637681	-1.000000	1
DMU19	0.623480	1.000000	1.000000	0.623480	-1.000000	16
DMU20	0.111111	0.111756	0.265301	0.994227	-1.000000	32
DMU21	1.000000	1.000000	1.000000	1.000000	0.000000	1
DMU22	0.295290	0.433698	1.000000	0.680865	-1.000000	26
DMU23	0.327381	0.413869	1.000000	0.791025	-1.000000	27
DMU24	1.000000	1.000000	1.000000	1.000000	0.000000	1
DMU25	0.318898	0.394958	1.000000	0.807422	1.000000	28
DMU26	0.333333	0.369603	1.000000	0.901868	-1.000000	30
DMU27	0.563783	0.786835	1.000000	0.716520	-1.000000	18
DMU28	0.432908	0.449761	1.000000	0.962529	1.000000	24
DMU29	1.000000	1.000000	1.000000	1.000000	0.000000	1
DMU30	0.378531	0.394215	0.558300	0.960215	1.000000	29
DMU31	1.000000	1.000000	1.000000	1.000000	0.000000	1
DMU32	0.776834	1.000000	1.000000	0.776834	1.000000	1

Source: Author (2019)

Legend: CRS_TE - Constant Returns to Scale Technical Efficiency; CRS_RANK - Constant Returns to scale ranking; VRS_TE - Variable returns to scale Technical efficiency; VRS_RANK - Variable returns to scale Ranking; SE - Scale efficiency; IRS; - increasing returns to scale; DRS - Decreasing returns to scale; (VRS_TE/CRS_TE) – add meaning of these acronyms here.

From the DEA results in Table 4, the names of the hospitals are represented by Decision making units (DMU). It is noted 32.25 % (10/32) of the hospitals were purely efficient with efficiency score of 100%. These includes DMU's 3, 4,7, 13, 14, 17, 21, 24, 29, and 31. These hospitals are fully making use of their inputs and consequently, they do not have to reduce their inputs. Their current level of inputs is the most optimal. The remaining 67.75% of the hospitals in Kisumu County were not optimal and the management can reduce the levels of all inputs to be fully efficient in their operations with the proportion of (1-efficiency scores). It is worth to note that all those hospitals that were fully efficient were also the same hospitals that were output efficient as shown by the CRS_TE column.

From the VRS_TE model, it can be noted from the results that 50 % (16/32) of the hospitals selected were found to be efficient in their input use. They DMU's 3, 4, 7, 9, 10, 12, 13, 14, 17, 18, 19, 21, 24, 29, 31, and 32. The rest of the hospitals which consist the 50 % were found to be inefficient in their output and input variables. The inefficiencies are an indication that the management of the affected hospitals ought to improve on the mentioned input/output variables.

4.4.1 Summary Statistics of Efficiency Scores

To ascertain the nature input oriented and output-oriented estimation, we undertook a descriptive statistic in which the minimum, the mean, standard deviation, and the maximum values were computed. The results are presented in table 4.4.

Table 4.4 Descriptive Statistics of Efficiency Scores

Variable	Obs	Mean	Std. Dev.	Min	Max
CRS	32	.6610208	.2814026	.111111	1
VRS	32	.7618733	.2817122	.111756	1

Source: Author (2019)

On average, a mean of .6610208 (66.10%) on CRS implies that overall, the hospitals in Kisumu County could reduce their inputs by 33.90 % while producing at the same level of output. On the other hand, a mean of 0.7618733 (76.19 %) of the VRS implies overall, a better hospital operation could reduce input consumption by 23.81%. The minimum efficiency for CRS and

VRS was 11.11% and 11.17 % respectively as indicated in Table 5. The most efficient hospital regarded as most optimal in both input and output model were 100% efficient. Furthermore, the standard deviation indicates the extent to which the efficiency scores for can change. The average rate of dispersion was 28.14% and 28.17% for CRS and VRS respectively

4.5 Determinants of efficiency in public and private hospitals Regression Results

To achieve the study objectives, both input and output models were analysed and presented in Table 4.5 and Table 4.6.

4.5.1 Input oriented model

Table 4.5 Input oriented model

VRS	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
beds	-0.00013	0.000959	-0.13	0.896	-0.00212	0.001862
immunization	-0.00016	0.000553	-0.29	0.771	-0.00131	0.000984
delivery	-0.01373	0.005006	-2.74	0.012	-0.02412	-0.00335
prenatal	0.049106	0.024654	1.99	0.059	-0.00202	0.100235
deltwo	0.001583	0.000517	3.06	0.006	0.00051	0.002655
delcsec	-0.0084	0.016747	-0.5	0.621	-0.04313	0.026331
postnatal	0.011776	0.004803	2.45	0.023	0.001815	0.021737
mpt	0.005513	0.002444	2.26	0.034	0.000444	0.010582
steralization	-5.1E-05	0.00029	-0.18	0.862	-0.00065	0.00055
opd	-0.00021	0.000317	-0.66	0.517	-0.00087	0.000448
_cons	0.447429	0.155766	2.87	0.009	0.124391	0.770467
Number of observations			32			
LR chi2(10)			27.19			
Prob > chi2			0.0024			
Pseudo R2			3.1193			
Log likelihood			9.2365085			

Source: Author (2019)

The study estimated Tobit regression model to establish the determinants of efficiency in the Hospitals in Kisumu County and results provided in Table 6. The study results established that the number of delivery care, Number of women receiving postnatal care within 48 hours of childbirth (PNCs), the number of women with three prenatal examinations completed as well as the number of medical terminations of pregnancy (MPTs) were statistically significant in influencing the input oriented model. For example, an additional delivery care in a hospital led to reduction in input efficiency by .1.37% when all alternative factors were constant. Equally, the result revealed that an additional number in either the number of women with three prenatal examinations completed or in the number of women receiving postnatal care within 48 hours of childbirth led to an increase in input efficiency of the hospital by 49.11% and 1.18% respectively. Lastly, the study reveals that holding all alternative factors constant, additional medical terminations of pregnancy marginally improved input efficiency by 0.6% (See table 6). Lastly, a constant of 0.4474287 implies that the efficiencies of input model when all other independent variables are held constant will assume this value (That is, the input efficiency will be inefficient).

4.5.2 Output oriented model

The study estimated Tobit regression model to establish the determinants of efficiency in the Hospitals in Kisumu County and results provided in Table 4.6

Table 4.6 Output oriented model

CRS	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
beds	0.000176	0.000984	0.18	0.86	-0.00186	0.002216
immunization	-0.00018	0.000567	-0.31	0.76	-0.00135	0.001001
delivery	-0.01545	0.005136	-3.01	0.006	-0.02611	-0.0048
prenatal	0.067091	0.02529	2.65	0.015	0.014643	0.11954
deltwo	0.001257	0.000531	2.37	0.027	0.000157	0.002358
delcsec	-0.0208	0.01718	-1.21	0.239	-0.05643	0.014825
postnatal	0.009541	0.004927	1.94	0.066	-0.00068	0.01976
mpt	0.003559	0.002507	1.42	0.17	-0.00164	0.008759
steralization	-0.00012	0.000297	-0.41	0.687	-0.00074	0.000495
opd	-0.00026	0.000325	-0.81	0.424	-0.00094	0.000409
_cons	0.544524	0.159787	3.41	0.003	0.213146	0.875902
Number of observations			32			
LR chi2(10)			25.49			
Prob > chi2			0.0045			
Pseudo R2			2.9485			
Log likelihood			8.4233811			

Source: Author (2019)

The study results established that the numbers of delivery care, Number of women receiving postnatal care within 48 hours of childbirth (PNCs) as well as the number of women with three prenatal examinations completed as were statistically significant in influencing the output-oriented model. For example, an additional delivery care in a hospital led to reduction in input efficiency by 1.55% when all other factors were held constant. Equally, the result revealed that an additional number in either the number of women with three prenatal examinations completed or in the number of women receiving postnatal care within 48 hours of childbirth led to an increase in input efficiency of the hospital by 0.67% and 0.95% respectively (See table 7). Lastly, a constant of 0.5445239 implies that the efficiencies of output model when all other independent variables are held constant will assume this value. (That is, the output efficiency will be inefficient).

CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This part of the study summarizes and concludes the findings, gives the policy relevance of the findings, limitations of the study, and ends by proposing further areas of research.

5.2 Summary of the Findings

This study set out to establish the technical and scale efficiency of hospitals in Kisumu County. More specifically, the study aims were two front: to analyse both the technical and scale efficiency of both public and private hospitals in Kisumu County in the delivery of quality healthcare for the years between 2014 and 2017 and to determine the factors influencing efficiencies of both public and private healthcare utilities in Kisumu County.

The study targeted 86 hospitals in Kisumu county but due to resource constraint (in both time and cost), only 32 (37.21%) of them were able to reach for interview. The study used a primary data collected through semi-structured interviews and questionnaires. To examine the level of technical efficiency for each of t of hospitals in Kisumu County, two models were carried out these are VRS-INPUT Oriented DEA model and CRS-Output oriented DEA model.

5.3 Conclusion of the study

Out of the 32 of hospitals in Kisumu County analysed under the VRS-INPUT Oriented DEA model, 32.25 % of the hospitals were fully efficient with efficiency score of 100%. These hospitals are fully making use of their inputs and consequently, they do not have to reduce their inputs. Their current level of inputs is the most optimal. The remaining 67.75% of the hospitals in Kisumu County were not optimal and the management can reduce the levels of all inputs to be fully efficient in their operations with the proportion of (1-efficiency scores).

Equally, from the VRS_TE model, we established that 50 % of the hospitals selected in the study area were found to be efficient in their input use, while 50% were found to be operating inefficiently in output and input variables

The second objective of the study was to determine factors influencing input or output efficiency among hospitals in Kisumu County. The study established that the that the number of delivery care, Number of women receiving postnatal care within 48 hours of childbirth (PNCs), the number of women with three prenatal examinations completed as well as the number of medical terminations of pregnancy (MPTs) were statistically significant in influencing the input oriented model. Equally, we also established that the numbers of delivery care, Number of women receiving postnatal care within 48 hours of childbirth (PNCs) as well as the number of women with three prenatal examinations completed as were statistically significant in influencing the output-oriented model.

5.4 Policy Relevance

The study results indicated that some of the hospitals in study area were fully efficient operating at 100% while others operate below 100%.This therefore is an eye-blink to the management of the public hospitals especially the ministry of health in Kenya or private owners with several branched hospitals in the study area could be employing inputs they do not need to and therefore they should consider reduction to operate efficiently. On the same note, some of the hospitals in study area are already operating efficiently and thus they should match the management of the fully efficient hospitals to that of the less efficient hospitals.

The study concluded that a high number of delivery care negatively affects the efficiency of the hospitals in the study area. This implies that hospitals should maintain an appropriate size of delivery care in their hospitals to ensure that high number delivery care does not jeopardize their efficiency in their endeavours to optimize their efficiency. The management must always keep assessing the effects of delivery care on their efficiency to be able to take appropriate output efficiency decisions.

5.5 Limitations of the study

In using the DEA model in this study, the model is good at estimating y “relative" efficiency of a DMU. However, it converges very slowly to "absolute" efficiency. This means that it can solely tell how the hospitals within the study area are doing amongst themselves but not compared to other hospitals in the country wide. Furthermore, since DEA is a nonparametric technique; statistical hypothesis tests are difficult to measure.

5.6 Suggestions for Further Research

The study employed three inputs and seven outputs, which were majorly pertaining to maternal and child health. However, there are other factors which are thought to influence the efficiency of hospitals. Nevertheless, to enhance hospital efficiency, measures such as reducing costs or up surging production is merely relevant if quality is maintained.

The study notes that there may be alternative factors that influence efficiency and therefore this study proposes a further study on the role of alternative factors that have an effect on efficiency within the hospital industry .Further, the study encourages other researchers to investigate other factors that determine efficiency in different sectors of the economy to be able to optimize operations.

REFERENCES

Afonso, A. and M. St. Aubyn (2005); "Non-Parametric Approaches to Education and Health Efficiency in OECD Countries, "Journal of Applied Economics, 8, 227–246. Research Methodology on Data Envelopment Analysis (DEA)

Aigner, D.J.; Lovell, C.A.K.; Schmidt, P. (1977); "Formulation and estimation of stochastic frontier production functions". Journal of Econometrics, 6:21–37.

Ajibefun I, (2008)An evaluation of parametric and non-parametric methods of technical efficiency measurement: Application to small scale food crop production in Nigeria. Journal of Agriculture & Social Sciences 4(3): 95-100

Akazili, J., Adjuik, M., Jehu-Appiah, C., and Zere, E., (2013); "Using data envelopment analysis to measure the extent of technical efficiency of public health centres in Ghana". BMC international health and human rights,

Aldamak A, Zolfaghari S (2017); "Review of efficiency ranking methods in

Alrafadi S, Yusuf M, and Hisham B, (2016);Measuring efficiency in banks: A brief survey on nonparametric technique (Data Envelopment Analysis). International Journal of Business, Economics and Management 3(5): 52- 68

An-assessment-of-healthcare-delivery-in-Kenya-under-the-devolved-system, (2012): Devolution of Healthcare in Kenya Assessing County Health System Readiness in Kenya:https://www.healthpolicyproject.com/pubs/479_KenyaPETSCountyReadiness

Arshinova T, (2007);The problem of efficiency measurement and its solutions. Riga Technical University, Latvia,

Banker R.D., A. Charnes&; W.W. Cooper (1984); "Some models for estimating technical and scale inefficiencies in data envelopment analysis". Management Science, 30(9), 1078–92.

Berber, (2013) "Classical management thought [In Turkish: Klasikyönetimdüşüncesi]," Alfa BasımYayım, İstanbul, 2013.

Bryman, A. (2004). Qualitative research on leadership: A critical but appreciative review. *The leadership quarterly*, *15*(6), 729-769.

Bush R, (2007) Reducing Waste in US Health Care Systems. Journal of the American Medical Association. 2007; 297(8):871–4

Cassel K, Brennan T, (2007); Managing Medical Resources: Return to the Commons? Journal of the American Medical Association. 2007; 297(22):2518–21.

Center for Health Solutions in Kenya,(2013), CHS Forum on Health System Strengthening in the Devolved System of Government, https://www.chskenya.org/wp-content/uploads/2014/04/chs-forum-on-hss-in-devolution-report.pdf, accessed 7 September 2019

Charnes A., Cooper W. & Rhodes E., (1978); "Measuring the efficiency of decision-making units", European Journal of Operations Research, vol. 2(6), pp. 429-444

Charnes A., Cooper W., Golany B., Seiford L. & Stutz J., (1985); "Foundations of data envelopment analysis for Pareto-Koopmans efficient empirical production functions", Journal of Econometrics, vol. 30, pp. 91-107.

Charnes A., Cooper W., Seiford L. & Stutz J., (1983); "Invariant multiplicative efficiency and piecewise Cobb-Douglas envelopments", Operations Research Letters, vol. 2(3), pp. 101-103.

Charnes, A., W.W.Cooper& E. Rhodes (1978); "Measuring the efficiency of decision-making units". European Journal of Operation Research, 2(6), 429–44.

Coelli TJ, Rao DSP, O'Donnell CJ, Battese GE (2005);An introduction to efficiency and productivity analysis. London: Springer; 2005

Cooper WW, Seiford LM, Zhu J, (2011); In: Handbook on Data Envelopment Analysis. Cooper WW, Seiford LM, Zhu J, editor. New York: Springer; 2011. Data envelopment analysis: history, models and interpretations; pp. 1–40. Volume 1

Cooper, A. G., & Schindler, B. M. (2000). Sampling Techniques.

Cooper, W.W., L.M.Seiford& K. Tone (2007); "Data envelopment analysis: A comprehensive text with models, applications, references, and DEA-solver software" (2nd edn). New York: Springer.

data envelopment analysis. Measurement" 106: 161-172

Dino Rizzi,Vincenzo Rebba (2006); "Measuring Hospital Efficiency through Data Envelopment" Analysis when Policy-makers' Preferences Matter.An Application to a sample of Italian NHS hospitals

Dixon J. (2010), "Making progress on efficiency in the NHS in England: options for system reform", Nuffield Trust, 2010.

Downward, P., & Mearman, A. (2006). Retroduction as mixed-methods triangulation in economic research: reorienting economics into social science. *Cambridge Journal of Economics*, *31*(1), 77-99.

Eliyahu M. Goldratt, (1990);*What is This Thing Called Theory of Constraints*? (1990) ISBN 0-88427-166-8

English M, Ntoburi S, Wagai J, Mbindyo P, Opiyo N, Ayieko P, Opondo C, Migiro S, Wamae A, Irimu G, (2009); "An intervention to improve pediatric and newborn care in Kenyan district hospitals: understanding the context". Implementation Sci. 2009; 4(42) doi:10.1186/1748-5908-1184-1142. [PMC free article] [PubMed] [CrossRef

Erkie A and Andualem B, (2018) Review on Parametric and Nonparametric Methods of Efficiency Analysis

Farrell M.J., (1957) "The measurement of productive efficiency", J. R. Stat. Soc., 1957, 120, 253-281

Fried HO, Lovell CAK, Schmidt S (1993);The measurement of productive efficiency: techniques and applications. New York: Oxford University Press; 1993.

Gladovic (2012); "Quantification of Airline Business Efficiency using DEA" African Journal of Business Management Vol 6 (25)

Government of Kenya (2010); "National Guidelines for the Diagnosis, Treatment, and Prevention of Malaria in Kenya", Ministry of Public Health and Sanitation & Ministry of Medical Services. 2010.

Goverment of Kenya (2010); "Kenya Health Policy Framework 1994-2010, Analysis of Performance, Analytical Review of Health Progress, and Systems Performance", Kenya. 2010.

Government of Kenya (2016); 'Recurrent Expenditures, Health Information System, Hospital Statistics" Ministry of Health, Kisumu, 2015".

Grosskopf, S., S. Self, and O. Zaim (2006); "Estimating the Efficiency of the Systemof Healthcare Financing in Achieving Better Health, "Applied Economics, 38, 1477–1488.

HeriIswanto, (2011); "Hospital Efficiency and Data Envelopment Analysis (DEA)" An empirical analysis of Kemang Medical Care (KMC)

Hollingsworth B, (2008); "the measurement of efficiency and productivity of health care delivery". Health Economics 17: 1107-1128.

Institute of Medicine (IOM) (2001) Crossing the Quality Chasm. Washington, DC: National Academies Press; 2001.

Jacobs R, Smith PC, and Street A (2006); "Measuring efficiency in health care: analytic techniques and health policy". Cambridge, UK: Cambridge University Press, 2006

Jonathan Cylus, Irene Papanicolas and Peter C. Smith,(2016); "Health system efficiency How to make measurement matter for policy and management"

*Kirigia JM, Asbu EZ, (2013); "*Technical and scale efficiency of public community hospitals in Eritrea": an exploratory study. *Health Econ Rev. 2013 Mar 16; 3(1):6. Epub 2013 Mar 16*

Kirigia JM, Emrouznejad A, Sambo LG (2002); "Measurement of technical efficiency of public hospitals in Kenya: using Data Envelopment Analysis". J Med Syst. 2002; 26:39

Kirigia JM, Emrouznejad A, Sambo LG, Munguti N, Liambila W.(2004), "Using data envelopment analysis to measure the technical efficiency of public health centers in Kenya". J Med Syst. 2004

Kizito, L., Kariuki, J., Muthami, L., Mutai, J., Ojakaa, D., Agina, O., Okoth, J., Muleshe, S., Bwonya, J. and Wasunna, M.K.,(2015) "National Study to Review existing Policy Documents and Identification of upcoming Priority National Health Policy issues in East African Community Partner States: Kenya Country Report", Kenya.

Koopmans T.C.,(1951), "An analysis of production as an efficient combination of activities". In: T.C. Koopmans (Ed.), Acticity Analysis of Production and Allocation, New York, Wiley, 1951,

Kumbhakar S, and Lovell K, (2000); Stochastic Frontier Analysis, Cambridge University Press, Cambridge, UK, 2000

Lindell, O., Eriksson, L., & Strender, L. E. (2007). The reliability of a 10-test package for patients with prolonged back and neck pain: could an examiner without formal medical education be used without loss of quality? A methodological study. *BMC musculoskeletal disorders*, *8*(1), 31.

McGlynn E, Shekelle P, Chen S, Goldman G, Romley J, Hussey PS, de Vries H, Wang M, Timmer M, Carter J, Tringale C, Shanman R, (2008); Health Care Efficiency Measures: Identification, Categorization, and Evaluation. http://www.ahrq.gov/qual/efficiency/index.html

Ministry of Devolution and National Planning,(2015), Improving Healthcare Delivery in Kenya, Nairobi: Ministry of Devolution and National Planning.

Ministry of Health, (2006),Taking the Kenya Essential Package for Health to the Community: A strategy for the Delivery of Level One Services, Nairobi: Ministry of Health.

Ministry of Health, (2013), Kenya *Service Availability and Readiness Assessment Mapping*, Nairobi: Ministry of Health.

Mujasi N.P, Asbu E.Z, Puig-Junoy. J (2016), "How efficient are referral hospitals in Uganda? A data envelopment analysis and tobit regression approach" Mujasi et al. BMC Health Services Research (2016)

Murillo R, (2004) Economic efficiency and frontier techniques. Journal of Economic Surveys 18(1): 33-77.

Nassiuma, D. K. (2000). Survey sampling: Theory and methods. *University of Nairobi press: Nairobi*.

Noffke, S. (2005). Action Research. Research Methods in the Social Sciences. B. Somekh and C. Lewin.

Othman M., Foo L., Karim M. and Andaziz Y, (2010); "Total Factor Productivity Efficiency Changes in A Malaysian Hotel Chain", Int. J. Revenue Management, vol. 4, pp. 327-343.

Polit, D. F., & Beck, C. T. (2013). *Study guide for essentials of nursing research: appraising evidence for nursing practice*. Lippincott Williams & Wilkins.

Roman M, and Gotiu L, (2017) Non-parametric methods applied in the efficiency analysis of European structural funding in Romania. MPRA 18(2): 80548

Salvatore D, (2008); "Managerial economics: principles and worldwide applications". New York: Oxford University Press; 2008.

Sekaran, U. (2006). John Wiley & Sons Research methods for business: A skill building approach.

Skaggs NT. Carlson (1996); Microeconomics. London: Blackwell Publishers; 1996.

Taylor W.F (2008): *The Principles of Scientific Management*, Digireads Publishing, Stilwell, KS, 2008.

Toma P, Paolo P, Zurlini G, Valente D,andPetrosillo I, (2017); A non-parametric bootstrap-data envelopment analysis approach for environmental policy planning and management of agricultural efficiency in EU countries. Ecological Indicators 83: 132-143

Valdmanis V, Rosko M, Mutter R (2008), “Hospital quality, efficiency, and input slack differentials”. Health Serv Res 2008; 43: 1830–1848. Crossref. PubMed.

Wamai, R.G, (2009); “The Kenya Health System-Analysis of the Situation and Enduring Challenges”, International Medical Community, JMAJ, 52 (2): 134-140. 2009.

Wanjau, K.N., Muiruri, B.W. and Ayodo, E,(2012); “Factors Affecting Provision of Service Quality in the Public Health Sector: A Case of Kenyatta National Hospital”, International Journal of Humanities and Social Science, 2 (13): 114-125. 2012.

Wayne L Winston,(199); “Operations Research: Applications and Algorithms”, 2ndedition, PWS-Kent Publishing, Boston, 1991

Weaver, M.R., &Deolalikar, A. (2004). Economies of scale and scope in Vietnamese hospitals. Social science & medicine, 59 1, 199-208 .

Williams A, (1998); Priority setting in public and private health care. A guide through the ideological jungle. Journal of Health Economics. 1988; 7:173–183.

World Bank (2014),” Delivering Primary Health Services in Devolved Health Systems of Kenya: Challenges and Prospects”

World Health Organization, (2007); “Everybody's business: strengthening health systems to improve health outcomes” WHO's framework for action. Geneva, Switzerland: World Health Organization, 2007.

Yawe B, (2010); “Hospital performance evaluation in Uganda: a super-efficiency data envelope analysis model”. Zambia SocSci J. 2010; 1(No.1): Article 6

Zaheer, Arshad &Rehman, Kashifur&Saif, M. Iqbal, 2008. "Development and testing of a business process efficiency scale," MPRA Paper 54467, University Library of Munich, Germany.

Zere, E., (2014). Hospital Efficiency in Sub-Saharan Africa: Evidence from South Africa. World Institute for Development Economics Research (WIDER), Working Paper No. 187.

Zikmund, W. G., & Babin, B. J. (2010). Exploring marketing research (10th edn) South-Western Cengage Learning.

Zinn J, Flood A (2009), "Commentary: slack resources in health care organizations fat to be trimmed or muscle to be exercised"?. Health Serv Res 2009; 44: 812–820. Crossref. PubMed

APPENDICES

APPENDIX I: RESEARCH LETTER

Dear respondent,

I invite you to participate in a research study titled "TheTechnical and Scale Efficiency of hospitals in Kisumu County. This is often a project intended for the aim of satisfying the wants to accomplish a master's degree in Business Administration at the University of Nairobi, Faculty of Business.

Your participation during this research is voluntary. Your answers stay confidential and anonymous. Information from this research is kept under wraps and reported solely as a collective grand total. Nobody, however the researchers can understand your individual answers to this questionnaire. If you agree to participate in this project, please answer the queries on the form as well as possible. It ought to take about 30 minutes for the process to complete. Many thanks for your support in this necessary endeavor.

Yours sincerely,

Joan Winnie Anyango Ochiel

APPENDIX 2: QUESTIONNAIRE

Part A: General information

1) Hospital ID…….
2) Names of the hospital……
3 Category
    (1) Public
    (2) Private
    (3) Other …….(Please specify)
3) Age of the hospital …… (In Years)

Part B: Health Service Inputs

4) This section captures the Health service input variables of your hospital for a period between 2014 and 2017. Kindly fill in the number of the respective variable in each year. Where necessary, supporting documents such as records will be required.

S/No	Input/year	2014	2015	2016	2017	Total
1	What was the total Number ofchild immunization in your hospital in					
2	What was the Number ofDelivery care in your hospital in					

3	What was the Number of beds in your hospital n					

Part D: Health service output

5) This section captures the Health service output variables of your hospitalfor a period between 2014 and 2017. Kindly fill in the number of the respective variable in each year. Where necessary, supporting documents such as records will be required.

S/No	Output/year	2014	2015	2016	2017	Total
1	What was the total Number of women with three prenatal examinations completed in your hospital in					
2	What was the total Number of deliveries in your hospital in					
3	What was the total Number of deliveries per caesarean section in your hospital in					

4	What was the total Number of women receiving postnatal care within 48 hours of childbirth (PNCs) in your hospital in					
5	What was the total Number of medical terminations of pregnancy (MPTs) in your hospital in					
6	What was the total Number of male and female sterilizations in your hospital in					
7	What was the total Number of outpatient consultations (OPD) in your hospital in					

Thank you