TECHNICAL EFFICIENCY OF HOSPITALS IN EAST AND WEST WOLLEGA ZONES, OROMIA REGION, ETHIOPIA.

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A THESIS SUBMITTED TO JIMMA UNIVERSITY, INSTITUTE OF HEALTH, DEPARTMENT OF HEALTH ECONOMICS, MANAGEMENT AND POLICY, IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF THE DEGREE OF MASTERS OF SCIENCE IN HEALTH ECONOMICS.

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Abstract

Back ground:

In the past few decades, health care efficiency has become as an issue of great interest to many governments and private sectors. Persistent growth in health expenditures coupled with fiscal pressures have led to widespread calls for efficiency improvements. Ethiopia's five-year Health Sector Transformation Plan (2015/16-2019/20) also calls for improvements in efficiency of resource use along with continued investments in PHC. Despite of different studies carried out regarding the efficiency measurement, only few were able to conduct at hospital level using two-stage DEA aiming at explanation of the efficiency score.

Objectives: *The objective of this study was to measure the technical efficiency (TE) of the hospitals in East and west Wollega zone, Oromia region, Ethiopia.*

Methods: *This study utilized cross sectional data (record review) of 2017/2018**(**2010 EFY) for 11 hospitals during time period. The analysis of hospitals was in three major categories, grouped into primary, general, and specialized hospitals to be analyzed distinctively. Three inputs (salary of total staff, total recurrent expenditure and total number of beds) and four outputs (number of outpatient visits, number of inpatients, number of delivery and family planning clients) were used. Data was analyzed in the first stage using DEAP Version 2.1output oriented model, in the second stage the efficiency sore of each hospital was examined for determinants of the inefficiency using stata v 14.2 left censoring Tobit model.*

Result: *The efficiency results indicated that on average the inefficiency observed in the hospitals was both in technical and scale inefficiency with closer efficiency score mean 77.8%, SD 0.157 and 87.9%, SD 0,154 respectively. This implies that on average technically inefficient hospitals could increase their output by about 22.2% without additional input. Six (54.5%) out of eleven hospitals exhibited constant returns to scale while five (45.5%) experienced variable returns to scale in their operations. Four operated in increasing returns to scale, and only one hospital showed decreasing returns to scale. In the second stage DEA, the inefficiency score was considered for regression. The coefficient for Physician to total clinical staff ratio, presence of clinics/hospitals and service year of the hospital had a negative signs and were statistically significant at 5 percent level of significance.*

Conclusion: *The hospitals expenditures (inputs) increased more than the equivalent increase of output. This overall low output production for studied hospitals might be brought on by inappropriate management of resources including work force and low health care demand.*

Key words: *Technical/ scale efficiency, variable return to scale, determinants of inefficiency.*

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Table of contents

List of Figures

List of tables

List of Acronyms

Acronym	Description
AE	Allocative Efficiency
ALOS	Average Length of Stay
ANC	Ante-natal Care
COLS	Corrected Ordinary Least Square
CRS	Constant returns to scale
DEA	Data Envelopment Analysis
DMU	Decision Making Unit
DRS	Decreasing Return to Scale
FP	Family Planning
FY	Fiscal Year
GDP	Gross Domestic Product
GLE	Gain of Life Expectancy
HLTF	High Level Taskforce on Innovative International Financing for Health Systems.
HMIS	Health Management Information System
HSDP	Health Sector Development Program
IMF	International Monetary Fund
IRS	Increasing Returns to Scale
IS	Information System
LDC	Less Developed Country
MOH	Ministry of Health
NGO	Non-Governmental Organization
OBA	Output-Based AID
OECD	Organization for Economic Cooperation and Development
PAC	Public Accounts Committee
PMTCT	Prevention from Mother To Child Transmission
PNC	Post-Natal Care
PTEC	Pure Technical Efficiency Change
RA	Ratio Analysis
SE	Scale Efficiency
SEC	Scale Efficiency Change
SFA	Stochastic Frontier Analysis
SFA	Stochastic Frontier Analysis
SSA	Sub-Saharan Africa
TC	Technological Change
TE	Technical Efficiency
TEC	Technical Efficiency Change
TFP	Total Factor Productivity
TFPC	Total Factor Productivity Change
TGE	Total Government Expenditure
VRS	Variable returns to scale
WB	World Bank
WHO	World Health Organization
WHO-CO	World Health Organization Country Office

CHAPTER ONE

1. INTRODUCTION

1.1 Background

Sufficient funding and efficacious technology may be necessary conditions for achieving health gains, but experience in many countries confirms that they are not sufficient. Effective and efficient service delivery is the point at which the potential of the health system to improve lives meets the opportunity to realize health gains. Health service–delivery performance means access and use by those in need; adequate quality of care to produce health benefits; efficient use of scarce resources; and organizations that can learn, adapt, and improve for the future. All too often, potential benefits are not realized because service delivery underperforms (1).

The World Health Report 2000 pointed to very large apparent worldwide variations in efficiency at the system level. The pursuit of efficiency is therefore one of the central preoccupations of health policy-makers and managers(2).

In the past few decades, health care efficiency has become as an issue of great interest to many governments and private sectors. This rise in interest is basically geared towards meeting the desired expectations of citizens by satisfying their health care needs. A growing population coupled with increasing scarcity of health care resources make health care a challenge for governments across the world as they endeavor to meet public expectations of proper health care service delivery(3). Persistent growth in health expenditures coupled with fiscal pressures have led to widespread calls for efficiency improvements(2). Ethiopia's five-year Health Sector Transformation Plan (2015/16-2019/20) also calls for improvements in efficiency of resource use along with continued investments in PHC (4).

The concept of health system efficiency as well as the related topics of cost effectiveness and value for money seeks to capture the extent to which the inputs to the health system, in the form of expenditures, labor, and capital, are used to secure valued health system goals(5).

In the definition of efficiency, the distinction should be made between technical and price (allocative) efficiency measures, which together comprise the overall (economic) efficiency, and scale efficiency. Price efficiency measures the firm's success in choosing an optimal set of inputs, technical efficiency is its success in producing maximum output from a given set of inputs(6).This study analyzes only one facet of efficiency, namely, technical efficiency.

In economic terms, the concept of efficiency can be defined as the relationship between scarce factor inputs and outputs. It examines how well scarce resources are converted into outputs. Health services are interventions provided to improve health for people in different health systems. This reflects the primary objective of health care from a social perspective. In this context, health care efficiency refers to how well health care resources are used to obtain health improvements (7).

Technical efficiency indicates the extent to which the system is minimizing the use of inputs in producing its chosen outputs, regardless of the value placed on those outputs. An alternative formulation (which is equivalent when there are constant returns to scale) is to say that it is maximizing its outputs given its chosen level of inputs(8). Within the context of healthcare services, technical efficiency may then refer to the physical relationship between the resources used (say, capital, labor and equipment) and some health outcome. These health outcomes may either be defined in terms of intermediate outputs (number of patients treated, patient-days, waiting time, etc. (7).

Data envelopment analysis (DEA) has emerged as an effective and popular method for evaluating the efficiency of decision-making units (DMUs) in different sectors including the health sector (9).

DEA compares service units considering all resources used and services provided, and identify the most efficient units or best practice units (branches, departments, individuals) and the inefficient units in which real efficiency improvements are possible. This is achieved by comparing the mix and volume of services provided and the resources used by each unit compared with those of all the other units. It has been successfully employed for assessing the relative performance of a set of firms that use a variety of identical inputs to produce a variety of identical outputs. The principles of DEA date back to Farrel (6).

Efficiency is measured relative to a best-performance frontier that is determined by a representative peer group. Put differently, a firm's efficiency was measured relative to the efficiency of all other firms in the industry and it was technically efficient if it operated on the best practice production frontier in the industry. Hospitals that compose the “best practice frontier” are assigned an efficiency score of one (or 100%) and are deemed technically efficient compared with their peers(10).

DEA computes technical efficiency measures that are either input or output oriented. The purpose of an output-oriented choice is to estimate by how much output quantities can be proportionally increased without changing the input quantities used. Alternatively, one could also determine how much input quantities can be reduced without changing the output. Both output and input-oriented models are useful in identifying the same set of efficient/inefficient health facilities. Most public health facilities however, have no control over most inputs especially the deployment of human resources for the public health sector. For instance, the staffing capacity of each public facility is determined centrally by the Ministry of Health, and the facility in-charges have no control over the size of the health facility personnel, and therefore of their inputs. Even where inputs (e.g. labour) might be underutilized, it is not within their power to dispose of excess inputs(10) (11).

Taking into account, returns to scale allows separation of the concept of technical efficiency into pure technical efficiency and scale technical efficiency. Pure technical efficiency reflects the way in which production unit resources are managed while scale efficiency or scale technical efficiency determines whether production unit operates at an optimal scale or not. The optimal scale is understood here as the best situation that can achieve the production unit by increasing proportionally the quantity of all its factors (7).

1.2 Statement of the problem

As highlighted in the 2010 World health report, efficiency is critical to sustainability: progress towards universal health coverage will require not just more money for health but more value for money. It was estimated in the 2010 Report that 20–40% of all resources spent on health are wasted (12).

A review of more than 300 studies analyzed the efficiency and productivity of global health-care delivery found that hospital efficiency, on average, was about 85%, meaning the hospitals could achieve 15% more than they do for the same cost, or the same levels of service at a 15% reduction in cost. The same study showed that in many countries, hospital care absorbs more than half and up to two thirds of total government spending on health. The worldwide workforce inefficiency cost exceeds US$ 500 billion annually. Applying a median inefficiency rate of 15% to the proportion of total health spending consumed by hospitals in each world income region, almost US$ 300 billion is lost annually to hospital-related inefficiency. Most countries fail to fully exploit the resources available, whether through poorly executed procurement, irrational medicine use, misallocated and mismanaged human and technical resources or fragmented financing and administration. But there is nothing inevitable about this and there are many shades of inefficiency. The enormous variation between countries in obtaining higher levels of coverage and better health outcomes for their money and the gap between what countries achieve and what they could potentially achieve with the same resources is alarming for the intensive study(13).

Health expenditure in Sub-Saharan Africa (SSA) has improved over the years with several recent efforts to improve resource commitments to the health sector. Health outcomes in the region have, however, seen little improvements over the years. Several reasons, including the efficiency of health expenditure, have been given to justify this mismatch. While raising more money for health is crucial for lower- income countries striving to move closer to universal coverage, it is just as important to get the most out of the resources available. Finding the most efficient ways to meet the multiple challenges health systems face is also an issue for these countries that might be struggling to sustain high levels of coverage in the face of constantly increasing costs and growing demand(1).

The relative efficiency of health system of 35 countries in Sub Saharan Africa analyzed using DEA model showed that, on average, the health systems of these countries have an efficiency score between 72% and 84% of their maximum level. Hospitals in Sub Saharan Africa (SSA) consume 45-69% of government health spending while up to 70% of medical equipment kept idle. Similarly, a WHO study of 18 low- and middle-income countries revealed that beds in district hospitals stands idle, only 55% of beds were occupied on average, well below the recommended level of 80–90%. These opportunities for efficiency gains should also be seen as a means of extending coverage for the same cost. The study suggested several general reasons for the broader systemic failure observed, however, specified and quantified metrics are needed for individual countries(14).

Despite these all facts, studies on health expenditure efficiency have mainly focused on developed regions with little attention to SSA(1).

In some SSA including Ethiopia, different studies have used different inputs and outputs to measure efficiency of hospitals. Only first stage DEA model was used in most studies to identify the level of efficiency of hospitals, while determinants of technical efficiency were examined in a few countries using a censored-Tobit regression model. Study conducted in Eritrea and Burkina Faso employed two stage DEA using panel data. Likewise, Joses M Kirigia1 and Eyob Z Asbu(15)measured technical efficiency of 19 hospitals in Eritrea using DEA.

To improve the problem of inefficiency, they suggested inefficient hospitals collectively could have become efficient by increasing their total outputs and boosting the quality of services provided by primary health care facilities by transferring the excess health workers (inputs); Doctors, nurses and midwives, and laboratory technicians to health centers. The study employed data that were five years old; the results were not meant to uncritically inform current decision-making processes, but rather to illustrate the potential value of such efficiency analyses. Furthermore, their suggestion of transferring excess health workers might not be trustworthy due to the fact that in the back ground of that study it was stated, " every category of Eritrean employee by far fewer than the region," there were , for example, five times fewer physicians per 10,000 of population than the regional average(15).

Paul Marschall et al (16) measured the technical efficiency using the first stage DEA among a sample of 25 primary health facility in Burkina Faso. They used data collected by a comprehensive long-term cost information system which covers both supply and demand side, and which contains information about direct and indirect costs but not aggregated by year if it were a panel data. They found that only 11(44%) were technically efficient by first stage DEA, but there was no or only weak pair wise correlation between the environmental variables. The main limitations were the sample data, recommended incentives to the people in catchment area to overcoming demand side barriers that can raise issue of feasibility and sustainability.

Un like the above, most studies conducted in different SSA countries such as Gambia, Benin, Kenya, Ghana, Sierra Leon, Cameroon, Botswana, (3),(17),(18),(19),(20),(21),(22), were employed non parametric one-stage DEA, which only involve standard DEA analysis. This one-stage DEA is unable to explain the determinants of technical inefficiency such as environmental influences and other causal factors which are beyond the control of the facility managers.

Kiriga et. al (18) measured technical efficiency of 54 public hospitals in Kenya using DEA. The result indicated that 26% of the hospitals found technically inefficient. To improve the problem of inefficiency, they suggested to transfer, decrease or sell excess inputs and create demand to increase output. However, since they used a one time period data and one – stage DEA model the results might be partial and their suggestion of selling excess inputs might not be appropriate due to the fact that in most developing countries there is shortage of health care resources.

Renner et al (20) measured the technical and scale efficiency among a sample of 37 peripheral health units in Sierra Leone. They used a one time period sample data and employed Data Envelopment Analysis. They found that, 22(59%) were technically inefficient and 24(65%) were scale inefficient. The main limitation here again was that the sample data set. Since they used a single time period data and one stage DEA model it might led to immature conclusion due to shallow observations.

The limited studies conducted in Ethiopia shows that the health care system hemorrhage money. A study conducted in 1552 health posts selected from seven regions of Ethiopia using DEA model showed that at the national level, only 2.84 and 5.67 percent of the sample health posts were fully technically efficient, with average overall technical and pure technical efficiency estimates of 58 and 79.6 percent, respectively. This result indicates high potential for improving the efficiency of the health posts(23). The problem here is the data set as it was the secondary data taken from the regional health bureau annual reports. Another study conducted in 16 health centers selected from three Districts of Jimma Zone, west Ethiopia Using two stage DEA model also revealed that only 3 out 16 (only 18%) of health centers were technically efficient(24). It was only one time period data to analyze the productivity changes that might come from the ongoing primary health care system reforms. This study also used similar data set.

Only 29% of the primary hospitals selected from four major regions of Ethiopia were pure technically efficient(4), and the bed occupancy rate was 51 percent(4). If the 17 inefficient primary hospitals were efficient as the pure technically efficient primary hospitals in the study, given current output levels, an input savings of 647 clinical and 937 non-clinical staff or 31 million birr in human resource expenditures, 60 million birr for drugs and supplies and 96 million birr for indirect expenditures was possible (4). These estimates were a high standard. They reflect the savings that would be realized if all primary hospitals were as efficient as their peers along the efficiency frontier. This analysis for primary hospitals demonstrates potential areas where improvements in resource allocation and use could lead to more efficient health service provision. However, additional evidence on the most cost-effective health providers for certain primary care services is needed and they did not attempt to show why potential efficiencies or inefficiencies occur. The factors accounting for these differences have not considered.

Abdu Kedir Seid (25)employed two-stage DEA model and used panel data in his study technical efficiency of 17 hospitals in Addis Ababa. In the CRS DEA model among the seventeen hospitals only 5 (29.4%) were technically efficient, and 5(29.9%) hospitals were scale efficient while the remaining 12 (70.1%) were scale inefficient. Censored-Tobit regression analysis indicated, among the explanatory variables six of them Age (years of operation), size (size of a hospital), teaching status, the proportion of total length of stay (inpatient days) to hospital beds and the proportion of medical doctors to the total staff were found statistically significant while the remaining two Own (type of ownership) and the coefficient of the proportion of inpatient treated per medical doctor were insignificant. Abdu Kedir went through DEA models and also well organized the Tobit regression analysis findings and revealed the severity and the magnitude of inefficiency of studied hospitals and indicated the urgency to measure the efficiency of health facilities if the scarce health care resources need to be utilized efficiently.

Although Getachew (26), measured efficiency of eight sample public hospitals from three selected largest regions, he employed Stochastic Frontier Analysis and identified three (37.5%) of hospitals were inefficient by testing the hypothesis. He used two outputs and five inputs to estimate the contribution of each input in the production process of health output. He disentangled the labor time into labor time of technicians and labor time of administrative staff and finally formulated the inefficiency model using salary of technical and non-technical staffs as its determinants. The main problem here is the data set and DEA model was not considered thus, the possibility of obtaining (estimating) the magnitude of resources (input) to be reduced or the output to be increased was missed if the hospitals were needed to operate at their optimal production frontier.

In order to get reliable results it is of great importance to choose the appropriate estimation technique, two-stage DEA in this study aiming at explanation of the efficiency score in relation to the output produced, resources utilized and set of environmental and organizational influences. Additionally, there was no research available on the efficiency assessment of hospitals in western part of Ethiopia. Thus, there is need for TE measurement of hospitals to shade light on the loss of the already limited and scarce health resources. Furthermore, the study will show the magnitude(efficiency score) or inefficiencies of hospitals indicating those need attention of managers and it provides researchers and policy makers base line in their effort of conducting research and designing appropriate policy in health care efficiency.

1.3 Significance of the study

Making known the inefficiencies of hospitals (efficiency scores) and shading light on the sources of inefficiencies (determinants of inefficiencies) are important policy concerns for the country's health system. This assessment would be useful for policy makers at different levels and hospital administrators to design appropriate policy and managerial interventions for efficient use of limited health care resources thereby to ensure that the consumers benefits from the resulting efficiency gains.

Additionally, by applying these tool managers within Health facilities will be better prepared to defend their budget requests - providing evidence of internal efficiency while ensuring effective and efficient spending of monies that are allocated. This may lead to hold better resource that can enhance the attempt to address the universal health coverage.

Moreover, the study will motivate researchers to conduct further studies in the area covering all hospitals in the region as well as country and also help them to replicate the methodology in other sectors of the economy as well.

More importantly, given that the available public health sector resources are limited, it is necessary to ensure that they are optimally used for providing health services to the greatest number of people possible ensuring better value for money.

CHAPTER TWO

2. Literature review

Previous empirical studies on the measurement of healthcare system efficiency evaluation were well documented in developed countries. For example, a study by Aristovnik (27) examined the healthcare system efficiency of 151 regions in old (EU-15) and 54 regions in new (Eu-13) member states in the European Union (EU) in the period 2007- 2012 using an output-oriented DEA technique. The results indicated that 27% and 53% of the old EU-15 member states were efficient based on constant returns to scale (CRS) and variable returns to scale (VRS) DEA models, respectively, while 30% and 69 % of the new EU-13 member states were found to be technically efficient based on CRS and VRS DEA models, respectively. The study further shows that there were significant differences in technical efficiency scores across regions. Similarly, there were remarkable variations within the efficient regions of their respective countries in the provision of healthcare services. Aristovnik's findings indicated that the most efficient regions were found in Sweden, Portugal, the Netherlands, Greece, and Spain, old EU members states, and most of them were characterized as being developed rural areas that were relatively less populated, while most of the inefficient regions were predominantly capital regions (large cities). There were some regions that were extremely technically inefficient as they were utilizing above-average healthcare inputs to produce below-average health outcomes. Hence, Aristovnik suggested that there was potential room to improve most of the inefficient EU regions by optimum use of their health inputs.

Based on the averaged efficiency scores, hospitals in Australia were performing at around 90 per cent of their potential efficiency (11). The similarity of the output-oriented and input-oriented scores across all hospitals suggests that Australian hospitals were generally equally as efficient at maximizing production from their given inputs, as they were at economizing on input use. On average, the most efficient hospitals were for-profit private hospitals.

Comparisons between the two model orientations highlight further differences by hospital ownership. The greatest gap between the output-oriented and input-oriented model scores was observed among not-for-profit hospitals, which were found to be more efficient at economizing on inputs rather than expanding production. In contrast, for-profit private hospitals were found to be better, on average, at expanding production rather than economizing on inputs, while public hospitals were found to be equally as efficient according to these two performance measures.

TE and scale efficiency scores of the district hospitals in Madhya Pradesh, India, were 0.90 and 0.88, respectively. Of the total district hospitals in the study, 20 (50%) were technically efficient constituting the 'best practice frontier'. The other half were technically inefficient, with an average TE score of 0.79 meaning that these hospitals could produce the same outputs by using 21% less inputs from current input levels. Twenty six (65%) district hospitals were found to be scale inefficient manifesting a mean score of 0.81 (SD=0.16). This implies that, on average, the scale-inefficient district hospitals could reduce their input size by 19% without affecting their current output levels(28). Another study conducted using panel data of 11 years (2001 to 2011) in 27 public sector hospitals of Uttarakhand, India, presented with the average Technical efficiency score of 70.4%. This implies that on average, hospitals were by 29.60 % off the best practice frontier under CRS assumption, and they could produce their output by using 29.60 % lesser inputs if they were operated on the best practice production frontier under the CRS assumption. The mean scale efficiency score was 91.3% shows that hospitals were not operating at optimal scale size. They were able to make 8.70% improvement in their scale efficiency by adjusting their scale size to the optimal level(29).

In Africa, the application of DEA in the health sector has been quite limited, but the DEA technique has been applied in a few countries to evaluate the efficiency of health facilities.

One study conducted by Samuel Ambapour to assess the relative efficiency of health systems of 35 countries in sub-Saharan Africa using Data Envelopment Analysis input oriented model with variable returns to scale assumption revealed that 14 out of 35 (40%)were technically efficient; on average, the health systems of these countries have an efficiency score between 72% and 84% of their maximum level indicating that these region states could reduce their resource consumption on average by 28% and 16% without output reduction(14).

Another study in Kenya by Urbanus M. Kioko, in his output oriented DEA model analysis he revealed that out of the 24 district hospitals, 12 (50%) were technically efficient using constant returns to scale assumption, 15 (60%) technically efficient in a variable returns to scale assumption, while 12 (50%) were found to be a scale efficient(30). The average CRS, VRS and SE technical efficiency scores were 72.6%, 78.8% and 91.5% respectively. This means that if the hospitals were operating efficiently, they could have produced 27.4%, 21.2% and 8.5% more health services outputs using their current levels of inputs. Alternatively, these hospitals could increase the production of their current levels of health services with 27.4%, 21.2% and 8.5% less of their existing health system's inputs.

The study in Sierra Leone applied the Data Envelopment Analysis approach to investigate the technical efficiency (TE) and scale efficiency (SE) among a sample of 37 PHUs. Out of the 37 PHUs, 15 (41%) were found to be technically efficient with a TE score of 100%. The remaining 22 (59%) were technically inefficient since they had a TE score of less than 100%. The overall sample average TE score was 78%/This implies that if the inefficient PHUs were to operate as efficiently as their peers on the efficient frontier, outputs can be increased by about 22% without changing the quantity of inputs used. About 65% of the PHUs were found to be scale in efficient, that is, they suffered from inefficiencies emanating from inappropriate size, i.e. being too small or too large. The average SE score for the sampled PHUs was 82%. This implies that if all PHUs had an optimal size, output would have increased by about 22% without increasing the input consumption. The scale inefficient PHUs had an average SE score of 72% (SD = 17%). (22)

An assessment of the technical efficiency of 20 "Center de Sante'et d Promotion Social" (CSPS) in Kossi province in Burkina Faso was conducted by Marschall and Flessa using the DEA technique (16) The findings revealed that there were considerable variations in technical efficiency scores across the CSPS. About 70 percent of the CSPS were found to be technically and scale efficient, while the remaining 30 percent were technically inefficient. The study also examined the determinants, which might affect the relative technical efficiency of the health centers using the Tobit regression model. The regression results indicated that distance to health centers affects the technical efficiency of the health centers. That is, the closer the village to the health centers, the greater the efficiency level of the health center will be. Thus, the findings indicated that the relatively technical efficient health centers were placed near to their catchment basin of the village.

The study in Benin employed DEA of VRS model assumption to analyze the technical efficiency among a sample of 23 zonal hospitals over a period of five years. Fifteen (65%) hospitals had a variable returns to scale technical efficiency average score between 63% and 86% this implying that there was room for increasing total outputs. Only four (17%) hospitals were technically efficient, this signifies that only those hospitals were operating at their most productive scale sizes (17).

Another study conducted in Eritrea found in its first-stage analysis imply that 68% hospitals were variable returns to scale technically efficient; and only 42% hospitals achieved scale efficiency. On average, inefficient hospitals could have increased their outpatient visits by 5.05% and hospital discharges by 3.42% using the same resources. The study employed data that were five years old, the results were not meant to uncritically inform current decision-making processes, but rather to illustrate the potential value of such efficiency analyses(15).

In Ethiopia, Abdu Kedir Seid (25) employed two-stage DEA model and panel data in his study of TE of 17 hospitals in Addis Ababa. He used three outputs and three inputs to estimate the contribution of each input in the production process of health output. The inputs were Labor input, capital input and drug supplies. Outputs include: Out patients, in patients and surgery. In the CRS DEA model among the seventeen hospitals 5 (29.4%) were technically efficient, and 5(29.9%) hospitals were scale efficient while the remaining 12 (70.1%) were scale inefficient. Censored-Tobit regression analysis indicates among the explanatory variables six of them (Age (years of operation) , size (size of a hospital), teaching status, the proportion of total length of stay (inpatient days) to hospital beds and the proportion of medical doctors to the total staff were found statistically significant while the remaining two Own (type of ownership) and the coefficient of the proportion of inpatient treated per medical doctor were insignificant. Abdu Kedir went through DEA models and also well organized the Tobit regression analysis findings and revealed the severity and the magnitude of inefficiency of studied hospitals and indicated the urgency to measure the efficiency of health facilities if the scarce health care resources need to be utilized efficiently.

Although Getachew (26), measured efficiency of eight sample public hospitals from selected Regions employed Stochastic Frontier Analysis, he used two outputs and five inputs to estimate the contribution of each input in the production process of health output. The outputs were outpatient visit and inpatient visit, while labor time spent by different professionals and administrative staffs, budget allocated to drugs, number of beds and depreciation of capital (building). He disentangled the labor time into labor time of technicians and labor time of administrative staff and finally formulated the inefficiency model using salary of technical and non-technical staffs as its determinants. The main problem here is the data set.

In order to get reliable results it is of great importance to choose the appropriate estimation technique, two-stage DEA in my study aiming at explanation of the efficiency score in relation to the set of environmental influences and other factors.

The estimated technical and scale efficiency scores for a total of 24 primary hospitals that were sampled from the four big regions Tigray, Amhara, Oromia, and Southern Nations, Nationalities, and Peoples' Region (SNNPR) in Ethiopia revealed that only 7 out of 24 (29%) primary hospitals were technically efficient. Only 4 out of 24 (16.7%) primary hospitals were scale efficient (4). The average technical efficiency score among the inefficient primary hospitals was 55% and the average scale efficiency score among inefficient primary hospitals is 65%.

This analysis for primary hospitals demonstrates potential areas where improvements in resource allocation and use could lead to more efficient health service provision.

However, additional evidence on the most cost-effective health providers for certain primary care services is needed and they did not attempt to show why potential efficiencies or inefficiencies occur. The factors accounting for these differences have not considered.

4.11 DEA analytical frame work

Although the core idea of efficiency is easy to understand in principle – maximizing valued outputs relative to inputs – it often becomes difficult to operationalize it when applied to real-life situations, numerous other issues arise when seeking to develop operational models of efficiency in health care, reflecting the complexity of the health care production process.

In light of the challenges in measuring efficiency and interpreting analysis, I have used a simple framework developed by WHO and European observatory(2) to clearly show efficiency concerns. Using this framework, five aspects of any efficiency indicator can be explicitly considered to clarify what precisely is being measured and to determine subsequent analysis or action.

- the entity to be assessed;
- the outputs (immediate outcomes) under consideration;
- the inputs under consideration
- the external influences on attainment (Environmental factors)
- the links with the rest of the health system (organizational factors)

Figure:1Visualization of DEA analytic frame work.

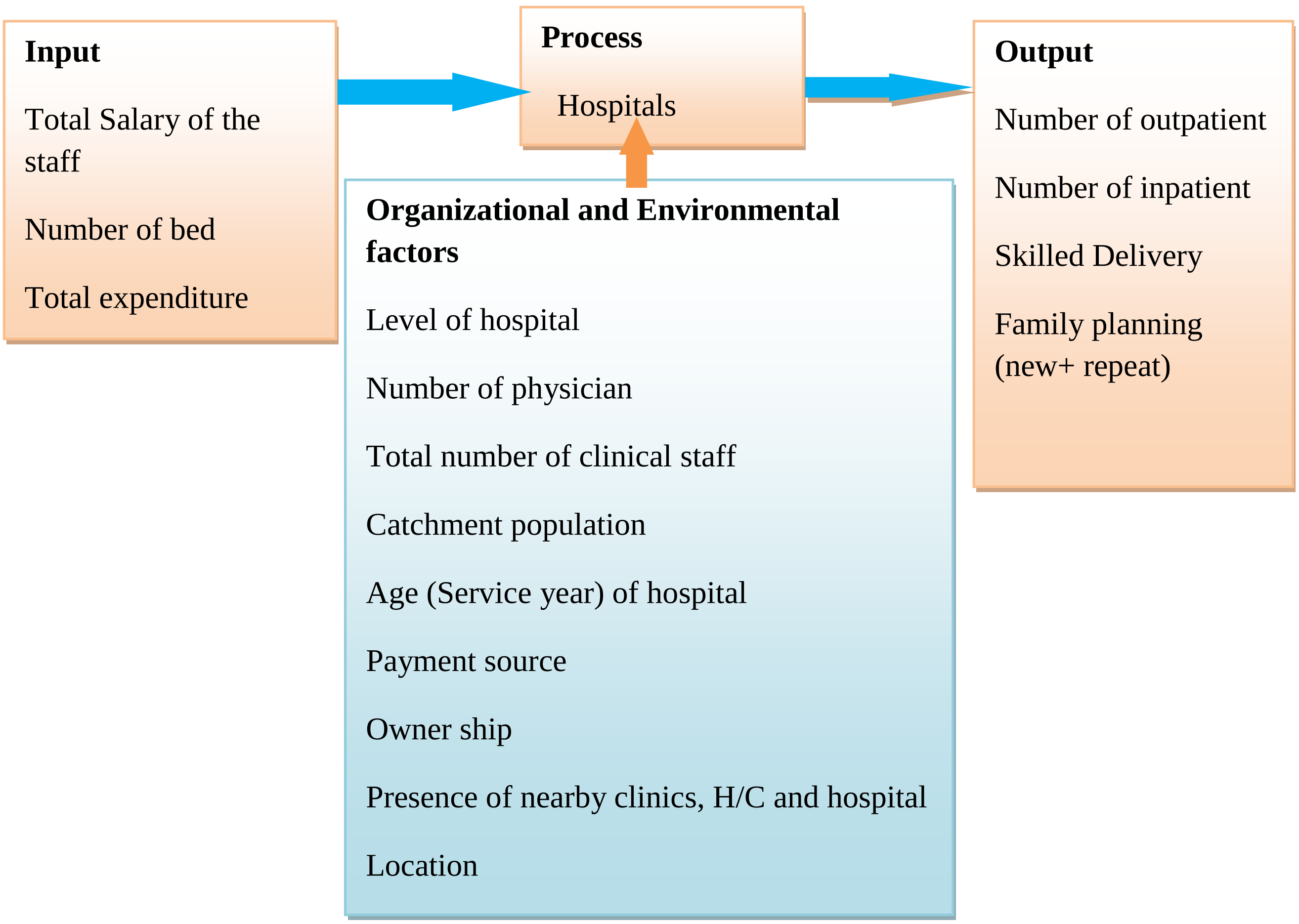


Figure 2.DEA Analytic frame work.

Source: Adapted from 2017 WHO on behalf of European Observatory on Health Systems and Policies (2);

CHAPTER THREE

3. OBJECTIVES

3.1 General Objective

This study has the general objective of measuring the technical efficiency of public hospitals in East and west Wollega zones, Oromia region, Ethiopia.

3.2 Specific objectives

Its specific objectives were:

To determine the technical efficiency of hospitals in east and west wollega zones.

To determine the scale efficiency of hospitals in east and west wollega zones.

To estimate the magnitudes of output increases and/ or input reductions that would have been required to make relatively inefficient hospitals in east and west wollega zones efficient;

To measure factors associated with the efficiency of hospitals in east and west wollega zones.

CHAPTER FOUR

4. Methods

4.1. Study area and Period

The study was conducted in east and west Wollega zones. These zones are located in the Oromia regional state, west Ethiopia. Their capital cities, Nekemte and Gimbi are located on the high way to Assossa and the renaissance dam of Abay River on 333 and 441 km away to the west from the capital city of the country, Addis Ababa respectively.

East and West Wollega zones' population estimated to be 1,535,415. and 1852252 in 2010 EFY(2017/2018) and there are 17 and 23 woerda, 287 and 542 kebeles respectively.

Two zones comprise a total of 12 hospitals, 5 in East and 7 in West wollega zone. There are 3 primary hospitals in East Wollega zone. One public referral hospital and one teaching hospital which is run by Wollega University are in Nekemte town.

In west Wollega zone, there are 4 general hospitals, 2 of them are religious organization owned, 2 public and 3 are public primary hospitals.

The study was conducted from 1-25 August 2018.

4.2 Study Design

Hospital based cross sectional study design using two stages DEA models was employed. All inputs and outputs were measured retrospectively for one full year: 2010 EFY or 2017/2018 Gregorian Calander.

4.3 population

4.3.1 Source of population

All hospitals located in east and west Wollega zone during the study period.

4.3.2 Study population

The study focuses on all hospitals in East and west wollega zone (N = 12) including 10 public and 2 mission(religious based organization) owned hospitals. Eight hospitals are distributed over the District (rural) of the zones while 2 referral and 2 general hospitals are located in Nekemte and Gimbi respectively.

4.3.3 Inclusion Criteria

Despite the fact that a total of 12 hospitals were in operation in 2018 in these zones, there were 11 out of 12 which started service before one year and maintained good medical records were included in the study.

4.3.4 Exclusion criteria

One hospital that was in operation but has not completed one year service was excluded.

4.4 Sample Size

Literatures do not suggest hard and fast rule on the sample size determination. For instance:
Golany B Suggested the following assumption(31):

Empirical Rule

There is an empirical formula used to choose a set of peer units, DMUs, in DEA. However, such a rule is neither imperative, nor does it have a statistical bases, but rather for convenience.

$$n \geq 2\,(s + m)$$

Where n= # of DMU(hospitals)

S= # input

m= # of output

4.5 Sampling technique and procedure

All of the 11 hospitals located in the zone and currently in operation were included in the study.
On the other hand, in the analysis the level and owner ship of the hospitals were considered as predictors of technical efficiency/inefficiency. In Ethiopia, public hospitals have been leveled into 3 grades. The first-grade hospitals are the primary, second - grade hospitals are general and the third-grade hospitals are tertiary hospitals. Hospitals of each grade differ in size, capacity, functions, and type of service they provide.

Therefore, in this study the efficiency measurement of these hospitals were conducted by treating them separately for comparison purpose according to their level, 5 primary hospitals, 4 general hospitals including 2 non Governmental general hospitals were compared and 2 specialized hospitals were also considered.

4.6 Data collection procedure

Data collection involves field visits to individual hospitals as hospitals do not completely report data to zonal HMIS. Hospitals were checked for having HMIS registry and regular monthly, quarterly and yearly report documentation at their immediate HMIS department as well as at the Zonal level. The (Lot Quality Assurance survey) LQAS review of each sampled hospital was made prior to the data collection. The two BSc holders supervisors and five data collectors having BSc in health sciences were recruited for data collection and were oriented for one day, They visited each of the hospital and reviewed the 2017/2018GC(2010 Ethiopian physical year) data by inputs, outputs and other necessary variables. The check list was adopted from the primary health care facility efficiency analysis data collection instrument of the WHO Regional Office for Africa(32).

The instrument was pre-tested for consistency and accuracy before actual data collection. Data collection preceded by a letter from the Ethical Committee of Jimma University. Consent was sought at each health facility before data collection. Supervision was conducted by the Principal Investigator and 3 supervisors to ensure that whether the data were properly or scientifically collected.

4.7 Study Variables

Input:

1. Labour in put (total yearly salary of total staff)
2. Capital input (the number of beds
3. Recurrent expenditures (total yearly expenditure on drugs, electricity, water & maintenance)

(Finance department record review was the data source)

output:

1. Number of inpatient (IPD) admissions
2. Number of outpatient (OPD) consultations.
3. Number of deliveries
4. Fp (new & repeat)

(Registry and HMIS report were the data source)

Determinants of hospitals inefficiency

Dependent variables	**Independent variable**
1. Inefficiency score	**Organizational**
	1 Level of hospital (primary/General
	2. Average bed occupancy rate
	3. Number of physician to total staff
	4. Total number of clinical staff
	5. Age (service year) of hospital
	Environmental
	1. Catchment population
	2. Payment source
	3. Ownership (Missionary /Government)
	4. Presence of private Clinics near by
	5. Location (Rural/Urban)

4.8 Operational definition

Outpatient visits –Services that do not require admission and provided in the outpatient department other than clients served in the MCH.

In patient visits - Clients Provided services/procedures that require a patient to be admitted.

Delivery – Clients received skilled delivery care in the hospital.

FP: All new and repeat clients who are acceptors of any contraceptive methods.

Payment source- It is the source of service fee that can be out of pocket or covered by health insurance.

Presence of clinics, Health Centers or hospitals nearby- When there were higher private clinics located within the same town or two hospitals found within the same town.

Level of hospital – In accordance to the 3 tire system, to indicate primary, secondary and tertiary level of hospitals.

Age(Service year) – Refers to the time or year elapsed since the hospital started giving service.

Recurrent expenditure – The total expenses of the hospital excluding salary in the year.

4.9 Data processing and analysis

In this study a two-stage Data Envelopment Analysis (DEA) was applied. In the first stage, DEA model was employed to estimate the efficient frontier and the hospital-level efficiency scores. The main advantage of DEA here is that it is able to deal with hospitals that employ multiple inputs to produce multiple outputs or services, which is typical of these study units. In addition, DEA not only identifies inefficient hospitals but also permits analysis of sources of inefficiency and quantification of magnitudes of inefficiencies in the use of hospital inputs and production of outputs. Thus, this model is suitable for efficiency study of multi-input and multi-output production hospitals (units).

Output-Orientation DEA model

DEAP Version 2.1 computer program developed by Professor Tim Coell(33) was used to calculate efficiency scores of each hospital. DEA computes technical efficiency measures that were either input or output oriented. In this analysis the output oriented DEA model was used for the efficiency analysis of the hospitals. The purpose of an output-oriented choice is to estimate by how much output quantities can be proportionally increased without changing the input quantities used. These hospitals have no control over most inputs like the deployment of human resources and therefore of their inputs. Even where inputs (e.g. labour) might be underutilized, it was not within their power to dispose of excess inputs. Thus, in line with related issue on the orientation of the estimation of efficiency, this study used an output-oriented model.

Hospitals that compose the “best practice frontier” were assigned an efficiency score of one (or 100%) and are deemed technically efficient compared with their peers (21). The efficiency of the hospitals below the efficiency frontier was measured in terms of their distance from the frontier. The inefficient hospitals were assigned a score between zero and one. The higher the score the more efficient a hospital was.

Efficiency level of hospitals in this study were examined in terms of their ability to use minimum (fixed) quantity of resources to produce as much output as possible (CRS). This is because public hospitals are usually provided with a fixed quantity of resources and are expected to produce as much output as they possibly can. The difference between the efficiency scores of CRS and VRS DEA models show scale efficiencies of hospitals. The scale efficiency is equal to the ratio of the CRS technical efficiency to the VRS technical efficiency.

However, it has been reported that the choice of the orientation (input or output orientation) has only a minor influence upon the efficiency scores obtained (21).

Mathematically, when a DMU employs only one input and produce a single output, efficiency is simply measured by;

Efficiency $= \frac{Output}{input}$

These hospitals however, employ more than one input in the process of their production and also produce multiple outputs. The equation specified above is usually then modified to consider the multiple inputs and output characteristic of the DMU by reducing these inputs to a single input and output as presented below (21);

Efficiency $= \frac{Weighted\ sum\ of outputs}{weighted\ sum\ of\ inputs}$, the maximization problem is then set as follows:

Max hc $= \frac{\sum_{r}^{s}=1\ uryr0}{\sum_{\mathrm{i}}^{\mathrm{m}}=1\ \mathrm{vi}\ xi\ 0}$

Subject to: $\frac{\sum_{\mathrm{r}}^{\mathrm{s}}=1\ \mathrm{ur}\ yrj}{\sum_{\mathrm{i}}^{\mathrm{m}}=1\ \mathrm{vi}xij}\ \mu r, vr \geq 0, r = 1, \ldots s; , i = 1, \ldots m$

J= Number of DMUs being compared in the DEA analysis

DMUj = Decision Making Unit number j

hc = Efficiency score of the DMU being evaluated by DEA

r = Number of outputs generated by the DMUs

vi = Coefficient or weight assigned by DEA to input i

yrj = Amount of output r from DMU j

xij = Amount of input ito DMU j

I = Number of inputs used by the DMUs

Ur = Coefficient or weight assigned by DEA to output r

In the stage two DEA, the Determinants of inefficiency such as institutional factors at the discretion of management as well as environmental factors beyond its control affect the efficiency of a hospital was examined (34). Some of the factors that influence the efficiency of a hospital considered in this study included ownership (Missionary/Government), distance, payment source, level, year of service, average bed occupancy rate, catchment population, number of physician to total clinical staff.

The efficiency scores of hospitals were examined using a censored Tobit model (using stata version 12.) to identify factors that influence inefficiency. In the Tobit model, for computational convenience, it was preferred to assume a censoring point at zero (15). To this end, the DEA technical efficiency scores were transformed into inefficiency scores, left-censored at zero using the formula:

Inefficiency score = $[\frac{1}{TE\ sore}]$ -1

The Tobit model is defined as follows:

$y^*\ i = \beta iXi + Ui$

$\gamma = yi^*\ \ jf \quad yi^* > 0$

$\gamma = 0 \quad jf \quad yi^* \leq 0$

Where, $U \sim N(0, \delta^2), and$

yi * is an unobserved latent variable representing inefficiency;

yi is the observant inefficiency score;

βi is a k×1 vector of unknown parameters; and

Xi is a k×1 vector of explanatory variables.

In the second stage, to explain inefficiency through Tobit regression analysis the DEA efficiency scores computed in the previous section were regressed against some institutional factors which are at the discretion of the hospital management and selected contextual/environmental (non-discretionary) factors that are beyond their control to estimate their impacts on efficiency. Technical efficiency scores obtained from first-stage DEA technique were taken as a dependent variable and then were regressed against independent variables to explain factors responsible for variation in technical inefficiency estimates across hospitals using the Tobit regression model v 14.2. Therefore, the Tobit regression model can be expressed as follows:

$yij^* = \alpha_o + \alpha i\chi i + \varepsilon ij$; $\varepsilon ij \sim N(o, \delta^2)$

$yij = yij^*$ if $yij^* > 0$;

$yij = 0$ if $yij^* \leq 0$; i= $1,2,3, \dots n$

Where : yij^* represents a possibly censored version of $yij; \alpha_o$ represents a constant term;

α_i represents the vector of unknown regression parameters;

Bi denotes the vector of independent variables (defined above);

ε is the random error term;

$DEA_{Ineff} = (yij)$ represents the technical inefficiency estimates of the i^{th} health post in a set of j = 1, …, n hospital under analysis.

Using the above equation, the basic Tobit regression model can alternatively be stated as follows:

$DEA_{Ineff} = \alpha_o + \sum_{i=}^{n} 1\, \alpha i\chi i + \varepsilon$

Therefore, the efficiency estimation analysis using the DEA technique was computed by a computer statistical software packages known as DEAP version 2.1 and all other descriptive statistical computations were made using SPSS version 20 and stata version 14.2 for Tobit regression analysis.

4.10.Data quality management

In order to make the study more valid and reliable, the error were kept minimal using possible measures such as using 5% of pretest (on one hospital, Gimbi General hospital) and some ambiguous terms and unnecessary information were reduced. Data quality assurance survey (LQAS) for each selected hospitals by comparing the numbers on the registration books and on health information system (HMIS) report on the concerned indicators prior to data collection. Training was given for 3 supervisors and 10 data collectors and monitoring completeness of filled questionnaire on time of data collection and using epidata for SPSS data entry.

4.11. Ethical Considerations

A letter from Jimma University was submitted to Oromia health Bureau and then subsequently to zonal health office, District and each hospitals. The aim and the purpose of the study was briefed and also informed consent was obtained from study hospitals before data collection. Confidentiality was assured to the study hospitals preceding the study and ethical standards were followed at all stages of this research.

4.12. Dissemination

The final result (report) will be presented for Jimma University, institute of Health, Department of Health Economics, Management and policy, to the District, zonal, regional and head quarter. Copy of the research will be given to each of the hospital's CEO and to the management board of the hospitals. Furthermore, presentation and panel discussion on the finding will be arranged with the concerned bodies and conduct at district, zonal and above levels.

CHAPTER FIVE

5. Results

5.1. Basic Characteristics of Hospitals

To conduct this study, five primary, four secondary and two specialized, total of eleven hospitals that started operation before the year 2010 EFY, (2017/2018GC) were included. Data were collected from all of the hospitals.

Except two NGO, all the selected hospitals were government owned hospitals and accountable to government health bureau at different level. Seven out of eleven, (six primary and one general hospitals), were distributed in the Districts of two zones away from the zonal towns. There were four hospitals located in two zonal towns, (one NGO owned general and one public general hospitals) were within radius of less than 1 km in Gimbi, west wollega zone capital city. Similarly, there were two specialized hospitals in Nekemte town, east wollega zone capital, about 5 km far away from each other. There were heath centers and clinics in both east and west wollega zonal towns. Among five, three Primary hospitals were distributed in different three districts of the east wollega while the remaining two were in two rural district of west wollega zone. Health centers and clinics were commonly found in every District of the zones and they were located in the same town with the primary hospitals were in. The east and west wollega zones hospitals service fee was from out pocket fee, and covered by community based health insurance. Community health insurance local boards located in both zones had an agreement with every primary hospitals in their District for their members service fee. In the same way Gimbi and Nejjo general hospitals were also engaged in the same agreement and providing the service. Table 1 below illustrates the characteristics of the hospitals in east and west wollega zones.

Table 1; Characteristics of NGO and public hospitals in east and west wollega zones with their efficiency scores in percent.

S/N	Variable	Category	Frequency	Percent
1	Level (type) of hospital	Primary	5	45.5
		General	4	36.4
		Specialized	2	18.1
2	Location of hospital	Rural	7	63.6
		Urban	4	36.4
3	Ownership of hospital	Public/Gov't	9	81,8
		NGO	2	18.2
4	Availability of health facility in the same town, Hospital, H/C, clinics that gives health service	Hospital	2	18.2
		H/C,clinics	9	81.8
5	Payment source	Out of pocket payment	4	36.4
		Both out of pocket & Health insurance	7	63.6

Distribution of hospitals' work force

The distribution of workers also vary even among hospitals on the same level, number of nurses were 7,43,42,46,45 in Sire, Gida ayana, Arjo, Mendi, and Begi Primary hospitals respectively. The number of midwives in the mentioned hospitals shows lesser variation, from eight in Sire to seventeen in Gida Ayana hospitals. The NGO owned two General hospitals (Aira & Gimbi Adventist) had seven medical Doctors each, while the minimum was ten in Sire and maximum fourteen in Mendi public primary hospitals. Numbers of nurses were very less in Sire primary hospital than the number of Doctors at the moment of study. It was recently established and on gradual process of filling staff. Total clinical staff composition was varying from 36 to 94 in Sire and Gida Ayana primary hospitals, from 74 to 157 in Gimbi Adventist and Nejjo general hospitals respectively. The number of Doctors, nurses, midwives and total clinical staff, were 41 and 56, 186 and 117, 24 and 17, 257 and 226 in Nekemt and Wollega University Specialized hospital respectively. Number of nurses in Nekemte specialized hospital exceeds the number of nurses in WUSH by 69.

Table 2 Some General Characteristics of work force in east and west wollega zones, Oromia regional state, 2018.

Hospital	level	Year of srvice	ABOR(%)	Total clinical staff	Physician to total clinical staff Ratio	Doctors	Nurses	Midwives	Total staff
Gimbi	General	8	24.2	104	0.12	15	40	16	200
Aira	General	89	88	104	0.07	7	57	8	170
Mendi	Primary	2	41.2	89	0.19	14	46	10	154
Begi	Primary	8	17.4	88	0.16	12	45	11	165
Nejjo	General	14	41	157	0.13	18	54	20	223
Gimbi Adventist	General	65	29	74	0.1	7	61	3	194
Gida Ayana	Primary	8	75	94	0.16	13	43	17	178
Sire	Primary	1.5	5	36	0.38	10	7	8	106
Arjo	Primary	8	49.2	81	0.19	13	42	10	182
Nekemte	Tertiary	75	12.7	257	0.28	41	186	24	410
WUSH	Tertiary	4	43.3	226	0.31	56	117	17	416

The service year of the studied hospitals vary from minimum of 1.5 year in Sire primary to 89 years in Aira general hospital. In primary hospitals, Average bed occupancy rate, physician to clinical staff ratio, and their catchment population vary from 5% to 75%, 0.16 to 0.38,142777 to 450,000 with SD 0f 27.48, 0.09, 115473.75 respectively. The average bed occupancy rate was 5% in sire primary hospital while having the maximum score of 0.38 physicians to clinical staff ratio. Conversely, Gida Ayana primary hospital recorded maximum bed occupancy rate, 75% while having least score, 0.16 of physician to clinical staff ratio. Similarly, Aira general hospital attained the maximum bed occupancy rate, 88% with the least score, (0.07) of physician to total clinical staff ratio. The catchment population (2018/ 2010 EFY) was minimum in sire primary,142,777 and maximum in Gida Ayana primary,450,000.

Further characteristics of studied hospitals are displayed with Tables in **Annex A.**

5.2. Description of Input and Output Variables

During the study period, in 2018, the 11 hospitals served 489802Out patient, 60537 inpatient service users, 15965 deliveries, and 31655 new and repeat any method acceptors of FP services,(Table 3).

Among the output produced by the studied hospitals, the minimum number in outpatient cases 9947, inpatient services 472, FP 74 were registered in Sire primary hospital. When we consider Arjo primary hospital it exceeds the output from Sire by 14276, 1996, 464 in outpatient, inpatient, and Family planning acceptors respectively.

The number of patients served in the outpatient department of Nekemte specialized hospital were 132277, for inpatient service 13638, Family planning acceptors 783, these exceed the number registered in Wollega University specialized hospital for similar services by 108821, 7449, and 659 respectively.

Table 3:Outputs considered among health service provision in hospitals in east and west wollega zones in the Oromia Regional State, (2018)

Level	Name of hospital	No. of OPD	No. of IPD	NO. of skilled Delivery	No. FP clients
Primary Hospitals	Gida Ayana	34012	3429	1275	1431
	Sire	9947	472	301	74
	Arjo	24223	2740	816	535
	Mendi	22954	2856	1161	674
	Begi	35000	4000	224	369
	Mean	25227.2	2699.4	755.4	617
	Median	24223	2856	816	538
	SD	10153.09	1342.7	481.4	507.06
	Min	9947	472	224	74
	Max	35000	4000	1275	1431
General Hospitals	Gimbi public	44944	7513	3186	1353
	Gimbi Adv.	29969	2912	210	875
	Aira	69751	12681	1390	4339
	Nejjo	63286	4107	2032	1093
	Mean	51982.5	6803.25	1706	1915
	Median	54115	5810	1714	1223
	SD	18045.43	4376.58	1243.45	1627.77
	Min	29969	2912	210	875
	Max	67731	12681	3186	4339
Tertiary Hospitals	Nekemte	132277	13638	3501	783
	WUSH	23459	6189	1863	124
	Mean	77858	9913.5	2682	453.5
	SD	76960.09	5267.24	1158.24	465.95
Grand Total	11 Hospitals	489802	60537	15965	31655
Minimum		9947	472	210	74
Maximum		132277	13638	3501	2109
Mean		44527.4545	5503.3636	1451.3636	2877.7273
Median		34012	4000	1275	783
SD		34087.795	4211.7327	1123.2617	6154.757

FP = Family planning

Those outputs considered in the study of these hospitals were produced using as many as total yearly salary expenditure for entire staff Birr 1150635854,(more than 1.1 Billion birr) total yearly recurrent expenditure was 213850068.5 (213 million Birr) and total of 1197 beds were used as inputs (Table 4).

When input consumption of each hospital was considered, the number of bed (proxied as a capital input) vary from 48 in Arjo to 80 in Sire primary hospitals and recurrent expenditure from 1450000 in sire to 17135728 in Begi primary hospitals. Sire primary hospital possessed 80 beds, the maximum among primary hospitals but scored least score in bed occupancy rate, only 5%, while 75 % of beds in Gida Ayana primary hospital were occupied by the patients during the study period.

Table 4:Inputs considered for health service provision in hospitals in east and west wollega zones in the Oromia Regional State, (2018)

Level	Hospital	Labor (Total salary of staff)	Capital (Number of bed)	Supply (Recurrent Expenditure)
Primary Hospitals	Gida Ayana	73,844,566	50	16,621,046.11
	Sire	3,714,948	80	1,450,000
	Arjo	6,117,614	48	13,655,524
	Mendi	71,605,416	76	14,901,706.9
	Begi	6,772,341	76	17,135,728
	Mean	32410977	66	12752801
	SD	36827601.81	15.62	6468372.77
	Min	3714948	48	1450000
	Max	73844566	80	17135728
General Hospitals	Gimbi public	9,986,668.34	150	4,187,191.08
	Gimbi Adv.	5,307,230.36	78	8236956
	Aira	9360000	100	74180319
	Nejjo	12,140,076	110	23,550,478
	Mean	9198493.68	109.5	27538736
	SD	2854361.6	30.13	32193150.55
	Min	5307230.36	78	4187191.08
	Max	12140076	150	74180319
Tertiary Hospitals	Nekemte	22,218,854.24	295	36,744,520.24
	WUSH	20,868,120	210	3,186,600
	Mean	21543487	252.5	19965560.12
	SD	955113.34	60.1	23729032.96
Grand Total	11	1150635854	1273	213850068.5
Minimum		3714949	48	1450000
Maximum		73844566	295	74180319
Mean		104603259.4	115.72	19440915.32
Median		9986668.3	80	14901706.09
SD		272108091.6	75.659	20799343.49

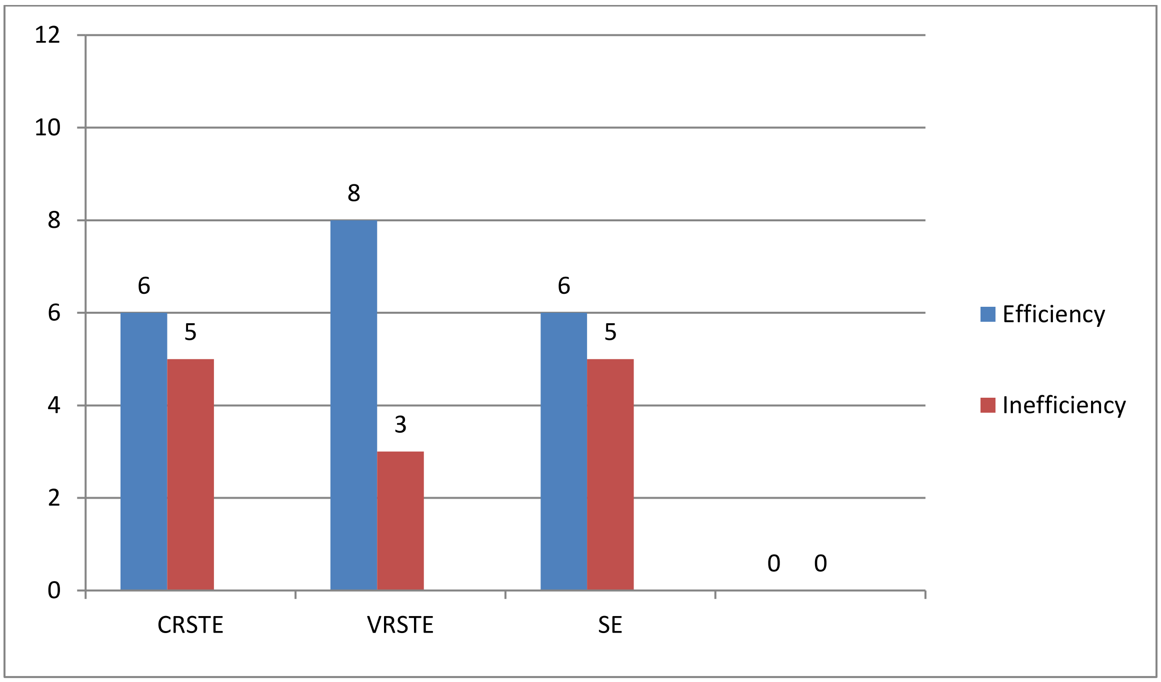
The table below illustrates the variation between efficient and inefficient hospitals in their input consumption and output production. There were differences in input consumption among the efficient and inefficient hospitals, but the variation in the output production was by far greater than the variation in input absorption.

Table 5. Characteristics of Efficient and inefficient hospitals with their average input and output.

		Input			**Output**			
		salary	bed	Expenditure	OPD	IPD	Delivery	FP
Efficient hospitals	Mean	22277963	125.5	26108179	61415	7351	2034	4923
	Median	11063372.17	105	20085762.06	54115	5810	1714	1393
	SD	25849570	91.57	268824	38729	4798	1091	8038
Inefficient hospitals	Mean	21653611	104	8982198	24261	3285	751	423
	Median	6772341	78	8236956	23439	2912	301	369
	SD	28750007	59	6935398	9423	2072	737	346

5.3. Technical and Scale Efficiency Scores

The eleven hospitals were included in the analysis in accordance with their level to measure the technical efficiency of hospitals. Six 6 (54.54%) of the 11 hospitals, Gimbi,Aira, Nejjo, Gida Ayana, Arjo, and Nekemte were technically efficient in constant returns to scale model assumption. The variable returns to scale model revealed that 8 (72.73%) of the 11 hospitals, Sire and Gimbi Adventist in addition to the above six were technically efficient in variable return assumption and 6 (54.54%) hospitals were scale efficient (Figure 3).)



CRSTE=Constant Returns to Scale Technical Efficiency, VRSTE= Variable Returns to Scale Technical Efficiency, SE= Scale Efficie

Table 6 shows scores for CRS TE, VRS TE, scale efficiency, and returns to scale.

Six out of eleven observed (54.54%) hospitals were constant return to scale technically efficient, and the remaining 5 (45.45%) were relatively inefficient. Among the inefficient, all hospitals had a constant return to scale technical efficiency score greater than 0.6 and mean 0.879 with SD of 0,154. The mean constant return to scale technical efficiency was 0.899, with a standard deviation of 0.152. The hospitals average constant return to scale TE score varied from 0.606 in Sire primary hospital to 1 in 6 hospitals.

Among eleven hospitals eight of them (72.72%) were VRS technically efficient, scoring 1, and the remaining 3 (27.27%) hospitals were VRS technically inefficient. The inefficient hospital had VRS TE scores more than 0.655.The overall mean VRS TE score was 0.945 (SD_0.114). Three hospitals, Mendi, Begi and Wollega university specialized hospitals had VRS TE score 0.655, 0.944 and 0.796 respectively. Moreover, the mean inefficiency score for pure technically inefficient hospitals was 0.844 (SD 0.119).

Six (54.54%) hospitals had a SE score of 1. The remaining 5 (45.45%) hospitals had scale efficiency scores of less than 1 and were thus considered scale inefficient. The distribution shows that 4 hospitals had a scale efficiency score of more than 0.944; the one remaining hospital (sire hospital) scored scale efficiency score of 0.606. The average scale efficiency score was 0.953 (SD- 0.117).

Among the scale inefficient hospitals the mean SE score was 0.897 (SD_0.154). All except one (Mendi primary hospital) the scale inefficient hospitals were operating at an increasing return to scale.

Table 6:Efficiency scores of hospitals in observed health service provision in east and west zones of the Oromia Regional State, Ethiopia (2018)

S/N	Hospital	CRSTE	VRSTE	Scale Efficiency	Returns to scale
Primary Hospital code					
1		1	1	1	constant
2		0.606	1	0.606	increasing
3		1	1	1	constant
4		0.648	0.655	0.988	decreasing
5		0.887	0.939	0.944	increasing
Mean		0.828	0.918	0.907	
SD		0.189	0.149	0.17	
General Hospital code					
01		1	1	1	constant
02		0.981	1	0.981	increasing
03		1	1	1	constant
04		1	1	1	constant
Mean		0.995	1	0.995	
SD		0.009	0.000	0.0095	
Tertiary Hospital code					
001		1	1	1	constant
002		0.770	0.796	0.967	increasing
Mean		0.885	0.898	0.98	
SD		0.163	0.144	0.233	
Over all Mean		0.899	0.945	0.953	
SD		0.153	0.114	0.117	

According to the result of DEA constant returns to scale assumption model, there were six efficient and five inefficient hospitals. Despite the fact that there were a variation in their input utilization in average, the differences were not as exaggerated as the average output differences. The inputs differences were by far less than the outputs differences.

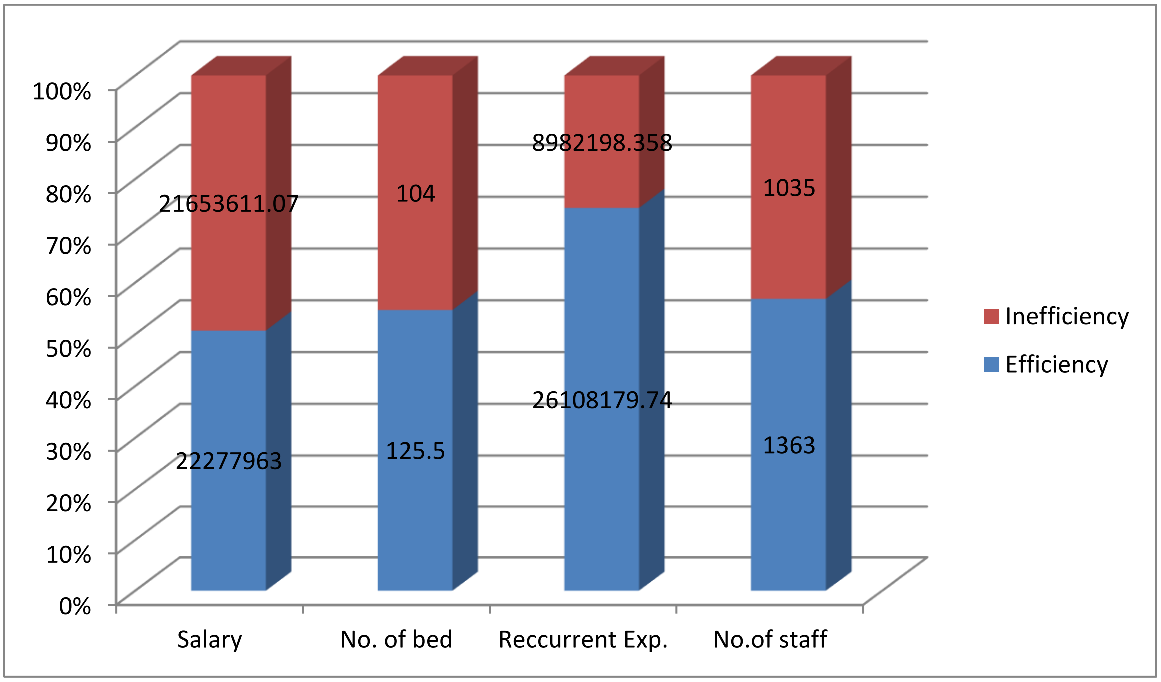


Figure 3:Mean inputs used by efficient and inefficient hospitals, in east and west wollega zones of Oromia regional state, Ethiopia, 2018.

In the same way the outputs produced (clients served) by efficient and inefficient hospitals also have differences. However, the differences are by far greater than that of the inputs' differences as seen in Figure 4. The following figure shows that the inefficient hospital's outputs are by much less than that of the efficient hospitals outputs.

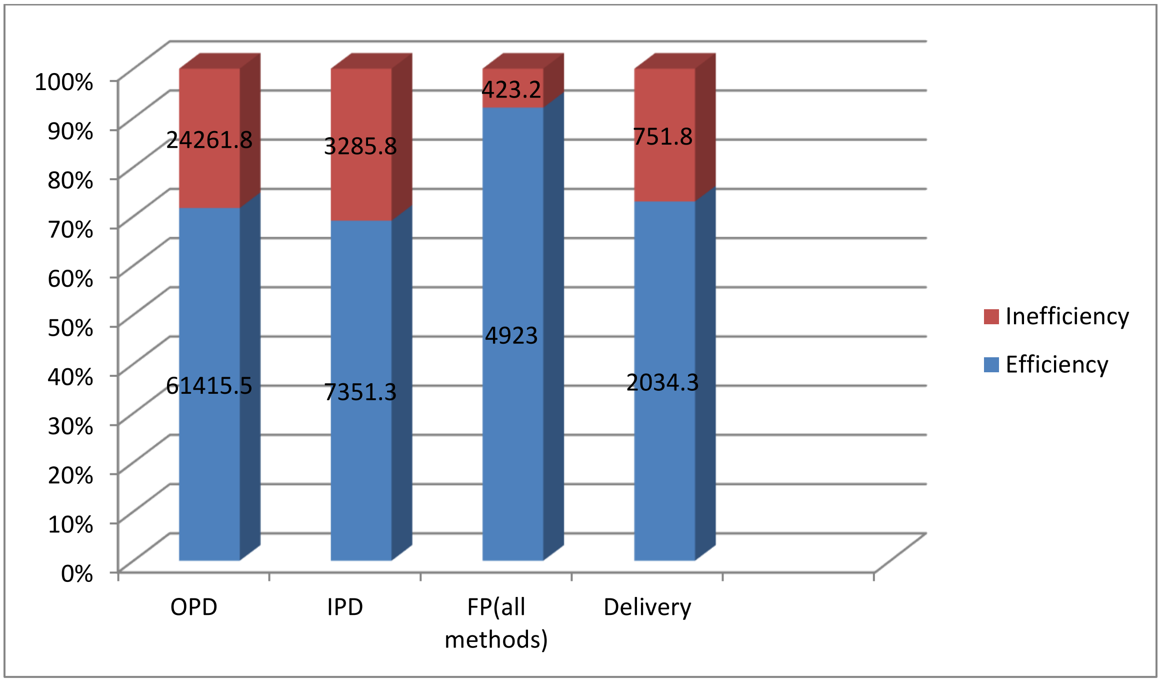
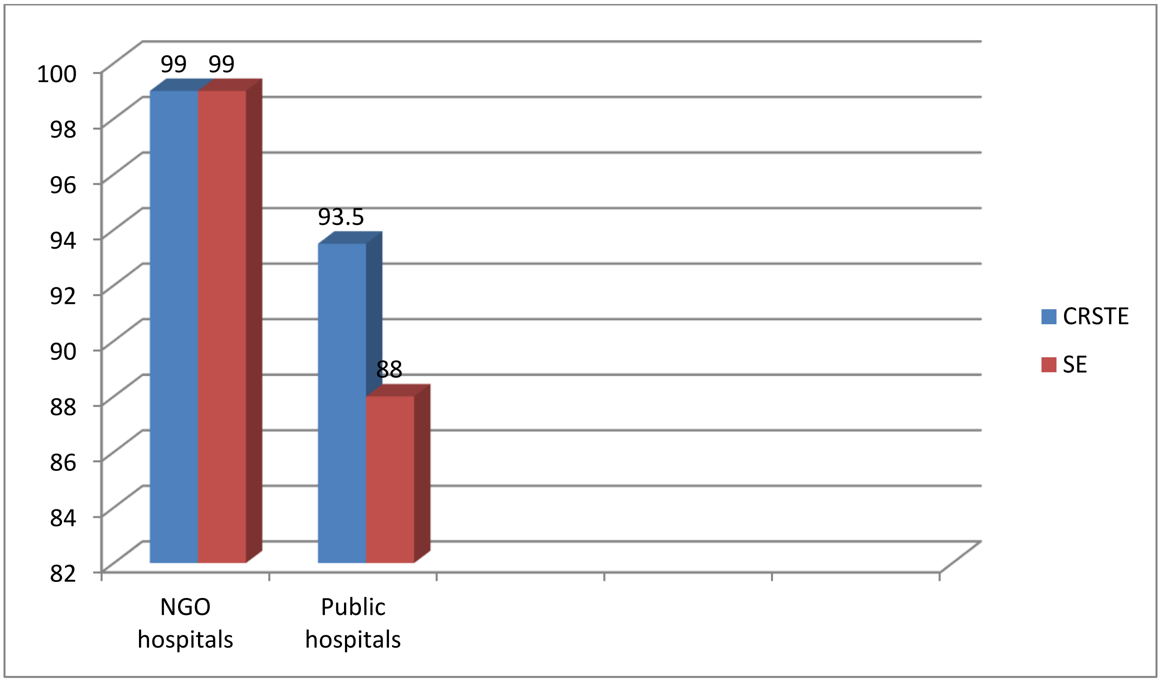


Figure 4:Mean outputs produced by efficient and inefficient hospitals, in east and west wollega zones of Oromia regional state, Ethiopia, 2018.

Among four General hospitals found in this study, 2 (namely Aira and Gimbi Adventist) were owned by NGO and the rest 9 were run by government. They had an average constant returns to scale technical efficiency score of 0.99 and 0.99,scale efficiency score of 0.935 and 0.88 for both NGO and Government owned hospitals respectively.



NGO = Non Governmental Organization

Figure 5 NGO and public hospitals efficiency score in percent.

Table 7 Comparison of average efficiency score of Non Governmental and public hospitals in east and west wollega zones with their efficiency scores in percent.

Facility	**CRS**	**SE**
Public hospitals	93.5	87.9
NGO hospitals	99	99

Actual and target inputs and outputs quantities for inefficient hospitals.

Since hospitals should be concerned with the output side, all the five inefficient hospitals should increase their level of outpatient visit by 30278, two of them should increase their level of family planning services by 3615, delivery by 1107 and their inpatient services by 3582 by attracting more admission/inpatient. However, if the hospitals are concerned with the level of inputs, Mendi hospital should decrease its expenditure of salary by 14,363,903, total of its recurrent expenditures by 1513463.098 Birr. Whereas, Wollega University specialized hospital should decrease its expenditure of salary by 12258282.84 and its number of bed by 96.

Table.8. Efficiency scores and actual and target inputs and outputs quantities for inefficient hospitals according to VRS assumption.

Table 9 Efficiency scores and actual and target inputs and outputs quantities for inefficient hospitals according to VRS assumption.

Hospital	Score	Input/Output	Actual quantity	Target Quantity	Difference	%
Code 4	0.655	OPD visit	22954	36854.32	13900.32	60.6
>	>	IPD	2856	4490.84	1634.84	57.2
>	>	Delivery	1161	1771.86	610.86	52.6
>	>	FP	674	1410.72	736.72	>100(More than double)
>	>	Yearly Salary	71605416	57241512.608	-14363903	-20
>	>	Total Expenditure	14901706.900	13388243.802	-1513463.098	-10.2
Code 5	0.939	OPD	35000	37265.842	2265.842	6.5
>	>	IPD	4000	4357.148	357.148	8.9
>	>	Delivery	224	722.386	498.386	>200 > two folds
>	>	FP	369	3258.460	2889.46	> seven folds
>	>	Salary	6772341	6772341	0	No reduction
>	>	Bed	76	76	0	No reduction
>	>	Total Expenditure	17135728	17135728	0	No reduction
Code 002	0.796	OPD	23459	37573.531	14114.53	60.2
>	>	IPD	6189	7778.770	1589.77	25.7
>	>	Delivery	1863	2341.549	478.549	25.7
>	>	FP	124	1062.508	938.508	>Seven folds
>	>	Salary	20868120	8609837.159	-12258282.841	58.7
>	>	Bed	210	114	96	45.7
>	>	Total Expenditure	3186600	3186600	0	No reduction

5.4 Factors associated with hospitals' technical efficiency

The following institutional and environmental factors affecting efficiency such as Physician to clinical staff ratio, location of the hospital, level of the hospital, owner ship, source of service fee, catchment population, presence of clinic, H/C or hospital adjacent to the study hospital, and service year of the hospital were considered as the explanatory variables.

The efficiency score of hospitals was taken as the dependent variable and analyzed in the censored Tobit regression model using stata version 14.2. In the Tobit model, for computational convenience, it was preferred to assume a censoring point at zero (35). To this end, the DEA technical efficiency scores were transformed into inefficiency scores, left-censored at zero.

The determinants of inefficiency of hospitals in this study were named as institutional and environmental factors and observed. Among them ownership, source of payment, location of the hospital, were statistically insignificant at 5% level of significance.

The coefficient for Physician to total clinical staff ratio, presence of clinics/hospitals at nearby and service year of the hospital had a negative sign and were significant at the 5 percent level of significance. A unit increase in the ratio of physician to total clinical staff would lead to a decrease in hospital expected inefficiency score by 2.8, holding all other variables in the model constant. The higher a hospital physician to total staff ratio, the lower the predicted inefficiency score. This indicated in average increasing the number of physician beyond the current number would enable the hospitals to operate more at their optimal production frontier. In the same manner, a unit increase in the number of health settings nearby would lead to a decrease in hospital expected inefficiency score by 0.43, holding other variables in the model constant. This implies that the competition among health care providers may not deteriorate efficiency, rather it develops. The unit increase in the service year of the hospital would lead to a decrease in hospital expected inefficiency score by 0.005, if other variables kept constant.

The coefficient for location of the hospital displayed/assumed a positive sign would have been to indicate if the number of hospitals located in urban increase by one unit, hospitals expected inefficiency score would increase by 2.7, while holding all other explanatory variables constant.

Table 10The results of the Tobit model for examined determinants of efficiency of hospitals in east and west wollega zones, Oromia regional state, 2018.

variables	Coefficient	t	p-value	95%CI	
Physician to clinical staff ratio	-2.83	-5.04	0.002	-1.46	-4.2
Presence of adjacent clinic/Hospital	-0.43	-3.49	0.013	-0.72	-0.13
Location of the hospital	0.27	1.68	0.144	-0.12	0.66
Total clinical staff	-0.002	-2.00	0.09	-0.005	0.0005
Service year	-0.005	-2.36	0.05	-0.009	-0.0002
Cons	0.034	0.08	0.942	-1.06	1.13

CHAPTER SIX

6.1 Discussion

This study used DEA to estimate the relative efficient resource used in the hospitals of east and west wollega zones. In these two zones eleven hospitals those were in operation at least for one year prior to this study were analyzed. In the output oriented CRS DEA model six (54.54%) among eleven hospitals were technically efficient. If we look at efficiency scores of each hospital, except those six (Gimbi public, Aira , Nejjo, Gida Ayana, Arjo and Nekemte hospitals)the remaining hospitals were found to be technically inefficient. The overall average technical efficiency score was 0.899 with a standard deviation of 0.153. Out of these, the average technical efficiency score of inefficient hospitals was 0.778(77.8%) with a standard deviation of 0.157. This implies that on average they could increase their output by about 22.2% without additional input. Among them Sire hospital had a least technical efficiency score of 0.606(60.6%) this also implies that Sire hospital on average could increase its output by 39.4% without increasing the input.

The average scale efficiency of the eleven hospitals was found 0.953 with a standard deviation of 0.117. Out of eleven, 6(54.54%) hospitals were scale efficient while the remaining 5 (45.45%) were scale inefficient. Except one, four were exhibited increasing returns to scale assumption. The average efficiency score of the scale inefficient hospitals was 0.879 with a standard deviation of 0.154 .This means that on average they were inefficient due to inappropriate size thereby on average they could reduce their size by 12.1% while leaving their output levels unchanged.

The study conducted in district hospitals of Madhya Pradesh, India (28) had closely related technical and scale efficiency scores of 0.90 and 0.88, respectively. But in our study the scale efficiency score was slightly greater than the score of technical efficiency (TE score of 0.778 and SE score of 0.0.879). This indicates that hospitals studied in India were more technically efficient while hospitals in east and west wollega zone were operating relatively more at their scale size.

Another study conducted using panel data of eleven years (2001 to 2011) in 27 public sector hospitals of Uttarakhand, India, with the average Technical efficiency score of 70.4% and scale efficiency score was 91.3%(29).This shows that the hospitals were relatively in better productive size and capacity than the hospitals in our study. Among the eleven hospitals in east and west wollega zones, six (54.54%) hospitals exhibited constant returns to scale implying that they were operating at their productive size; one hospital (Mendi) showed decreasing returns to scale and four (36.4%) hospitals, Begi, Gimbi Adiventist, Sire and WUSH) exhibited increasing returns to scale. This implies that they should scale down and expand respectively both their outputs and inputs in order to operate at their most productive size.

Several studies in Ghana (19)found varying degrees of inefficiencies for different levels of public and private health care providers. The study employed DEA to measure the efficiency of 17 public district hospitals and 17 health centers in Ghana showed, Eight (47%) District hospitals were technically inefficient, with an average TE score of 61% and a standard deviation (STD) of 12%. Ten (59%) hospitals were scale inefficient, manifesting an average SE score of 81% (STD = 25%)(19). In the case of east and west wollega zone hospitals, three out of five primary hospitals (60%) were technically inefficient, with an average score of 71.3%. This indicated that on average these inefficient hospitals could increase their current output by 29.7% without additional input. Those technically inefficient were also scale inefficient with an average scale efficiency sore of 0.907 (90.7%). One out of these 3 was operating in decreasing and two were operating in increasing return to scale. This implies that on average these scale inefficient hospitals should decrease and increase their scale size respectively to the optimal level by about 9.3%.

DEA was used to show that only 40% of public primary health facilities in South African Province of Kwazulu-Natal were technically inefficient with an average efficiency score of 90.6 %, and 58% were scale inefficient with an average score of 95.3% (36), while 45.5% of the studied hospitals in east and west wollega zones were both technically and scale inefficient with average scores of 77.8%, SD0.157 and 87.9%, SD 0.154 respectively. This indicates that studied (inefficient) hospitals in South Africa were relatively operating more efficiently in their scale size and capacity than the (inefficient) hospitals in east and west wollega zones. Because they needed either to increase or decrease their scale size on average by only 4.7% while the inefficient hospitals in east and west wollega zones had to increase (in four hospitals) their current scale size by 12.1% if they were to operate at their optimal scale.

More than half of the studied district hospitals in Namibia were technically inefficient with an average technical and scale efficiency score of 74.6% and 76.8%, respectively, in 2000/01(16).

DEA conducted in Zambia revealed that the overall Zambian hospitals were operating at 67% level of efficiency, implying that significant resources were being wasted. Only 40% of hospitals were efficient in relative terms. The study further reveals that the size of hospitals is a major source of inefficiency as well. Input constraint was also found to be a source of hospital inefficiency(37). Likewise, among inefficient hospitals studied in east and west wollega zones (four out of five, 80%) of them were demonstrated decreasing returns to scale indicating that the inefficiency were due to congestion of resources or size of scale of operation.

From a few DEA study conducted in Ethiopia, the one conducted in Addis Ababa among the seventeen selected hospitals (29.4%) were technically efficient the remaining (70.6%) hospitals were technically inefficient. The Overall average technical efficiency score was 0.776 with a standard deviation of 25.8%. Out of these, the average technical efficiency score of inefficient hospitals was 0.682 with a standard deviation of 25.4%. The technical efficiency scores among the inefficient hospitals vary between 0.294 and 0.941. That implied on average they could reduce their utilization of inputs by about 31.8% without reducing outputs.

The average scale efficiency of the seventeen hospitals were found 0.849 with a standard deviation of 23%. Out of these, (29.4%) hospitals were scale efficient while the remaining (70.5%) were scale inefficient. The average efficiency score of the scale inefficient hospitals was 0.786 with a standard deviation of 25% .That showed they were inefficient due to inappropriate size thereby on average they could reduce their size by 21.4% while keeping their output levels unchanged(25).

Among the determinants of the efficiency analyzed, three variables, Physician to total clinical staff ratio, presence of clinics/hospitals at nearby and service year of the hospital were found to be statistically significant at 5% level of significance. The coefficient for these mentioned explanatory variables had a negative sign.

For instance, the coefficient for Physician to total clinical staff ratio was -2.8, inferring that a unit increase in the ratio of physician to total clinical staff would lead to a decrease in hospital expected inefficiency score by 2.8, holding all other variables in the model constant. The higher a hospital physician to total staff ratio, the lower the predicted inefficiency score. This indicates that the average increase in the number of physician beyond the current number would enable the hospitals to operate more at their optimal production frontier.

The study conducted by Abdu Kedir in seventeen hospitals in Addis Ababa revealed similar finding with the coefficient for physician to total staff ratio was -3.33, p. value 0.046 at 5% level of significance, the proportion of medical doctors to the total staff was negatively related with inefficiency of the hospitals. The finding also showed that a unit increase in the ratio of physician to total staff would lead to a decrease in hospital expected inefficiency score. In another word, the higher the availability of medical doctors in the hospital, the more efficient the hospital would be.

The coefficient for variable age (service year of hospital) in this study had also negative sign. This implies that a unit increase in the service year of the hospital would lead to a decrease in hospital expected inefficiency score by 0.005, if other variables kept constant.

In the study conducted by Abdu Kedir in seventeen Addis Ababa hospitals the age(service year of hospital) was statistically significant variable for the inefficiency of hospitals with a negative relationship (coefficient -0.01469, p value 0.099), this variable result showed that it has a negative relationship with the inefficiency score at 10%. This indicated that due to the fact that as years of operation increases hospitals tend to have more experience to improve their technical efficiency(25).

It also shows that the service year of the hospitals contribute to the appropriate utilization of resources and in building the execution capacity of the work forces through experience.

In this study the coefficient of presence of health settings nearby had the negative sign(coefficient -0.43). In the same manner, a unit increase in the number of health settings nearby would lead to a decrease in hospitals expected inefficiency score by 0.43, holding other variables in the model constant. This implies that the competition among health care providers may not deteriorate efficiency, rather it develops.

6.2 Limitations of study

DEA analytical methodology attributes any deviation from the "best practice frontier" to inefficiency, even though some level of deviation could be due to statistical noise such as natural disasters or measurement errors. The natural disasters/ statistical noise, for instance, inflate/deflate the number of clients flowing to the hospital which can be taken as the increased level of output and result in unreliable efficiency score.

DEA is underpinned by a functionalist paradigm using a deterministic/nonparametric technique, it is difficult to use in statistical tests of hypotheses dealing with inefficiency and structure of the production function.

The data was not panel data and was not possible to observe the impacts of different health care reforms on the productivity change. Productivity change study is used to observe the influence of different health care reforms or initiatives brought on the performance of hospitals.

CHAPTER SEVEN

CONCLUSION AND RECOMMENDATION

7.1 Conclusion

This analysis for public hospitals demonstrated some potential areas where improvements in resource utilization and use could lead to more efficient health service provision within the facilities.

- The hospitals expenditures (inputs) increased more than the equivalent increase of output. This may indicate inefficiency in resource use such as inappropriate staffing, time and inappropriate input management relative to utilization rates.
- Referring to global normative recommendations, such as from the WHO, Ethiopia faces a substantial health worker shortage; however, health worker productivity is very low for hospitals studied in east and west wollega zones. These studied hospitals have on average one outpatient visits per clinical staff per day.
- This overall low output production for primary hospitals might be brought on by low demand and inappropriate management of inputs and clinical staff.
- The studied hospitals had significant potential cost-savings.
- On the other hand, the number of physician to the clinical staff ratio had a statistically significant impact on the technical efficiency of studied hospitals. In this study it was shown that a unit increase in physician to clinical staff ratio would lead to a decrease in hospital expected inefficiency score. The distribution of higher level with middle and lower level professionals would have significant effect on the technical efficiency of hospitals.
- The age (service year of the hospitals) was another significantly affecting the efficiency of hospitals. The other important point this finding indicated was that there were a gap in staffing procedure of the newly established health facilities. If the administrative and executive staffs that are filled with the newly established health settings are also newly coming to their professional career, these would affect the efficiency. The mix of professionals to facilitate experience share among work force.

7.2 Recommendation

The lower and middle level, zonal health offices, are expected to review the distribution of the work force within the health facilities in regular bases in accordance with the production (services provided).

The issue of hospital efficiency must be brought on board for discussion and awareness must be created on the scarce health resources that are being wasted in the hospitals. This needs the due attention of the higher administrative bodies to initiate and extend further to the individual health setting.

The experience sharing trend that has been in practice should be strengthened and focus on the magnitude of health resources lost that could have been saved.

In order to audit the efficiency of health facilities, give feed back and take corrective actions at regular bases it is necessary for the country to institutionalize efficiency monitoring within the national health management information systems.

Staffing procedure should consider the issue of work experience.

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Annex A

The service year of the studied hospitals vary from minimum of 1.5 year in Sire primary to 89 years in Nekemte specialized hospital. Average bed occupancy rate, physician to clinical staff ratio,,and their catchment population vary from 5% to 88%,0.07 to 0.38,142777 to 5 million with SD 0f 25.4, 0.095, 1433268.44 respectively. The average bed occupancy rate was 5% in sire primary hospital while having the muximum score of 0.38 physician to clinical staff ratio and conversely, Aira hospital attained the maximum bed occupancy rate, 88% with the least score, (0.07) of physician to total clinical staff ratio. The catchment population (2018/ 2010 EFY) was minimum in sire primary,142,777 and as many as 5 million in Wollega university specialized hospital while the mean was 987,823 for the studied hospitals.

Table 11 Summary of characteristics of eleven hospitals in east and west wollega zones of the Oromia Regional State, 2018.

Variable	No of Hospital	Mean	SD	Min	Max
Average bed occupancy rate	11	38.73	25.42	5	88
Physician to clinical staff	11	0.19	0.095	0.07	0.38
Catchment population	11	987823	1433268.44	142777	5000000
Total clinical staff	11	112.64	54.982	36	226
Service year of the hospital	11	25.59	33.22	1.5	89

The average bed occupancy rate among primary hospitals vary from 5 to 75, in Sire and Gida Ayana hospitals. Conversely the the ratio of physician to clinical staff was largest, 0.38 in Sire and minimum both in Gida Ayana and Begi,0.16.. The service year of hospital was the least (1.5 year) in Sire and maximum was (8 years) in Gida Ayana and Begi primary hospitals.Total number of clinical staff was largest in Gida Ayana (94) and the minimum was recorded in Sire (36).

Table 12 Characteristics of primary hospitals in east and west wollega zones of the Oromia Regional State, 2018.

Variable	No of Hospital	Mean	Median	SD	Min	Max
Average bed occupancy rate	5	37.64	41.6	27.48	5	75
Catchment population	5	262010.4	243275	115473.75	142777	450000
Service year of the hospital	5	5.5	8	3.43	1.5	8
Physician to clinical staff	5	0.21	0.19	0.09	0.16	0.38
Total clinical staff	5	77.6	88	23.71	36	94
Total staff	5	157	165	30.58	106	182

The Average bed occupancy rate was minimum (24.2) in Gimbi hospital and maximum was recorded (88) in Aira hospital. But the number for physician to clinical staff ratio was the minimum in Aira hospital (0.07) and the maximum was 0.13 recorded in Nejjo hospital. The total staff of Aira hospital was minimum with 170 while Nejjo hospital was the maximum with 223. The service year of these hospitals vary from 8 to 89, in Gimbi and Aira hospitals respectively.

Annexes B

Questionnaire

SECTION 1: BACKGROUND CHARACTERISTICS

1. Name of the zone ___________________________
2. Name of health district:________________________________
3. Name of health facility: ________________________________
4. Type of health facility:
   4.1 Specialized Hospital   yes/ No

   4.2 General Hospital   yes/ No

   4.3 Private Hospital   yes/ No

   4.4 Other, specify ____

5. Who owns the facility? Public /Private

Mission / NGO

Other, specify ____

6. When was the hospital established? Month/year______________________

7. What is the size of the hospital? Plotted on ________________Area square metre

8. What are the main economic activities in the district?

Encircle Yes /No

8.1 Agriculture (crops) Yes/No

8.2 Agriculture (animal husbandry) Yes/No

8.3 Industry Yes/No

8.4 HandicraftYes/No

8.5 Trading Yes/No

8.6 Others (specify)

9. Demographic profile of the catchment population: Reference year____________________________

9.1. Number of households ______________________

8.2 Population in the catchment area _________ M_____ F _________

8.3 Sex ratio (number of males/number of females) ____________________

8.4 Number of women of child bearing age (15–49 years) ______________________

8.5 Number of children under one year (0–11 months) _________________________

8.6 Number of children under two year (0- 23 months) ______________________

8.7 Number of children under five years (0–59 months) _____________________

8.8 Sex ratio (number of males/number of females) ________________________

8.9 Adult literacy rates (*number of people that can read and write in at least one* language / total number of people) x 100%

M _________ % ________

F _________% ________

8.10. What percentage of the catchment population lives in:

Rural areas ______ %_________Urban areas ______ % ____

8.11. How many KM far is the distant kebele from the hospital?_______________

8.12. How many KM far is the nearest kebele from the hospital?____________

9. In Table 3 below, list, *in order of frequency of use*, the means of transport commonly used by the communities in the catchment area to access health services. Then complete the rest of the table

Table 1 Communities means of transport

Means of transport	Available all year round?		If no, for how long is it not available? (Number of weeks per year)
	Yes	**NO**	

7. Are any parts of the district in accessible from the district office (for supervision, provision of supplies etc.) for one week or more in a year?

(*Inaccessibility means that the area cannot be reached by any* ***available*** *means of transport*).

Yes/No If yes, please continue with question 8.2 and 8.3.

If no, please go to question 9.

8.1 List the main geographical areas of the district affected and the number of weeks per year that they are inaccessible.

Table 2 Number of weeks Period of inaccessible geographical area

Geographical area	Reason for	inaccessibility per year	the year

8.2 What percentage of the district population lives in the affected areas? _______%

9. List the ten diseases that community representatives feel are the most important in the district (*based on the answers to question 7 in the health facility questionnaire*).

10.1 ________________________________ 10.6 ____________________________________

10.2 ________________________________ 10.7 ____________________________________

10.3 ________________________________ 10.8 ____________________________________

10.4 ________________________________ 10.9 ____________________________________

10.5 ________________________________ 10.____________________________________

11. Is it possible to tell on the basis of the health management information system which five diseases had the highest consultation rates in the district public health facilities in the past calendar year?

Yes If yes, please list the five diseases.

No If no, please continue with question 12.

11.1 ________________________________ 11.2 ____________________________________

11.2 ________________________________

SECTION TWO : input indicators

Human resource

1. Number of GP Doctors ________________
2. Number of gynecology & obstetric specialists ________
3. Number of emergency surgeons / surgeon ________/_______
4. Number of Environmental health officer_______________
5. Number of nurses __________________
6. Number of midwives ______________
7. Number of laboratory technicians _____________
8. Number of pharmacists _____________
9. Number of druggists ______________
10. Number of anesthetists_________Anestheologists___________
11. Number of X ray technicians _____________
12. Number of physiotherapists______________
13. Total number of clinical staffs____________
14. Number of administrators ____________
15. Number of ICT for health _____________
16. Total number of supportive staff____________
17. .Total number of personnel currently in the hospital ____________________
18. Number required according to establishment/standard _________________

Finance

1. What is the cost per bed per day?___________________
2. What is the bed occupancy rate?____________________
3. What is the total salary of the personnels?_______________
4. What is the price of electricity bill in the year?____________
5. What is the price of water bill in the year?____________
6. What is the price of maintenance in the year?_____________

Health and health-related resources funding and financial management

7 Is there a district health budget? **Yes** ☐ **No** ☐

Table 3 About sources of fund

Source	Specification of the budget amount							
	Provided funds		Recurrent costs (a)		Capital costs (b)		Total costs (a+ b)	% of total district funds
	Yes	No	Salaries	Operations				
Government								
NGO								
Donors								
Other sources specify								
Budget total								

8 Indicate which of the following payment modalities are in use for the services provided and or drugs dispensed in the health facilities.

Table 4 Type of payment

	Services		**Drugs**	
	Yes	No	Yes	No
Direct payment				
Social health insurance				
Private health insurance				
Community health insurance				

Other specify ____

____

____

Table 5 Different expenditure of the hospital

Type	Specification of the budget amount							
	Provided funds		Recurrent costs (a)		Capital costs (b)		Total costs (a+ b)	% of total district funds
	Yes	No	Salaries	Operations				
Government								
NGO								
Donors								
Other sources specify								
Budget total								

Drugs and supplies

1. What is the price of drugs consumed in the year?_____________
2. What is the price of other medical supplies in the year?__________
3. What is the amount of other recurrent expenditure?________________

Capital costs (proxied by number of beds)

1. What is the total number of beds? ______________________
2. What is the number of active(in use) beds?_________________

SECTION THREE

output indicators

1. What is the total number of adult inpatient? _____________________
2. What is the total number of peditric inpatient? _____________________
3. What is the total number of adult outpatients? ___________________
4. What is the total number of pediatric out patients?___________
5. What is the total number of clients received drugs /prescription from dispensary?_____________________
6. What is the total number of minor and major surgeries? Minor surgeries______________Major surgeries?____________
7. What is the number of C/S delivery?_______________
8. What is the number of appendectomies?_________________
9. What is the total number of clients received ANC? ANC1__________ ANC4___________
10. What is the number of PW received PMTCT? _________________
11. What is the number of PW tested for VDRL/PRP?________________________
12. What is the number of PW tested for HIV/AIDS?__________________
13. What is the number of PW received TT2 +? __________________
14. What is the number of clients received skilled delivery services? ______________
15. What is the number of clients received comprehensive obstetric services?_____________
16. What is the number of clients received PNC within 48 hours?_______in 6 weeks__________

17. What is the total number of clients receiving any contraceptive method?_________________
18. OCP ___________ Injectable _______________
Implant_____________IUCD_______________
19. TL _____________vasectomy ______________
20. What is the total number of under 5 children received services in IMNCI clinic?____________
21. What is the number of under 2 children received Growth monitoring & nutritional assessment in the < 5 OPD?_________________
22. . Number of children received penta 1________________
23. Number of children received penta 3 _________________
24. Number of children received measles ________________
25. Number of children fully vaccinated ________________
26. Number of total neonates received services in neonatal care unit?
27. Number of clients received Laboratory services(total) ____________
28. HIV/AIDS ________Urine analysis ________STD tests _________
29. clients tested for AFB _____________Others___________
30. Number of Adolescent received sexual health service _______________
31. Number of patients CAC?_____________

SECTION FOUR :

Infrastructure, Equipment and Supplies

1. Indicate the adequacy of the following physical conditions in the public health facilities in the district according to the members of the assessment team.

Table 6 Physical conditions

Physical conditions	**Adequate**	
	Yes	**No**
Lighting		
Sanitation facilities		
Water		
Ventilation		
Cleanliness		
Space(waiting, rooms)		
Refrigeration of vaccines		
Telephone		
Internet access		
Radio(intercom)		

2. Does the district have adequate transportation for: health management team (to carry out supervision, provision of supplie☐c.)? Yes ☐ No
3. Does the district have adequate transportation for health facilities to provide outreach services? Yes ☐ No ☐
4. Does the district have adequate transportation for transfer of emergency cases? ☐ No ☐
5. Does the district have sufficient resources to maintain its transportation? Yes ☐ NO ☐
6. Is a standard list available in the district for the equipment that the various health facilities should have? Yes ☐ No ☐
7. Indicate from which of the following sources the hospital get its drugs. Encircle the letter/letters of alternatives.

A.Government drug or medical stores in the district

B. Private drug wholesaler in the district

C. Private drug wholesaler elsewhere

D.NGO or other not for profit associations

8. Indicate the degree of satisfaction of the assessment team with the availability of the following resources in the district health facilities

9..Indicate the type of the private health facility nearby the hospital. 1.Clinic, higher,medium,lower 2.Drud store 3.Medical Laboratory

10 .Indicate the distance of private clinic near by by metre/KM___________________

Degree of satisfaction

Basic equipment _________________

Stationery ___________________

Linen ___________________

Cleaning materials____________________

Scale: Very Dissatisfied = 1 Dissatisfied = 2 Satisfied = 3 Very Satisfied = 4 Undecided = X

SECTION FIVE

Guidelines, Standards and Norms

1. Indicate whether guidelines or treatment protocols are available and in use in the health facilities in the district for the following issues:

Table 7 Availability of guide lines

Guidelines/ treatment protocols for	**Available to**			**In use to**		
	All	some	None	All	Some	None
Referral of obstetrical emergencies						
How to run an immunization session						
Family planning provision						
How to manage a child with diarrhea						
How to manage a child with fever						

2. Could you specify other guidelines inuse:____
____
____

DECLARATION

The undersigned, declare that this thesis is my original work, has not been presented in this or any other university and that all sources of materials used for the thesis have been acknowledged.

Name of the student: Abdi Wakjira Jigsa (BSc)

Signature __________________

Date of submission _____________________

This thesis has been submitted for fulfillment of requirement for the master of science in health economics with my approval as University advisor/ examiner.

Name and Signature of internal examiner for approval

Name: ____

Date._____________________

Signature __________________

Name and Signature of Advisors

1. Name: ____

   Date._____________________

   Signature __________________

2. Name: ____

   Date._____________________

   Signature __________________