Acknowledgements

The authors would like to thank many colleagues at the Federal Ministry of Health, Breakthrough International Consultancy, and Harvard T.H. Chan School of Public Health as well as Harvard Global Research and Support Services, Inc. for their valuable support and inputs for this report. The constant support from Dr. Mizan Kiros, Director of the Financial Resource Mobilization Directorate (FRM) of FMOH, Ato Mideksa Adugna from FRM, and other FRM staff was much needed for this work to come into fruition.

We would also like to extend our thanks to key staff at FMOH that provided the guidance and leadership during the primary health care cost study that provided the much needed data to conduct the efficiency analysis this report covers. Of particular note are: Dr. Addis Tamire, Ato Abdujelil Reshad, Dr. Sinetsehay Chanayalew, and Dr. Mekdim Enkossa. Furthermore, Anubhav Agarwal conducted the data cleaning and cost accounting that made it possible to utilize the data from the PHC cost study. Sarah Hurlburt provided editorial support and design of this report.

Grant support from the Bill & Melinda Gates Foundation as part of the Resource Tracking and Management (RTM) Project, a three year program, at the Harvard T.H. Chan School of Public Health in partnership with Breakthrough International Consultancy, PLC is gratefully acknowledged. All errors remain the responsibility of the authors.

Foreword

Measuring resource efficiency and productivity of primary health care facilities is one of the core components of the RTM project. The other four components focus on resource mobilization, resource allocation, resource utilization, and resource targeting for primary care. The PHC cost study is expected to provide timely and relevant evidence on the financing sources for the provision of primary care services; actual costs of providing PHC services and specific exempted services in health facilities; specific revenue sources for each health facility; and the current productivity of resources with potential for policies to promote efficiency gains.

Part of a series of papers, this second document examines the productivity and efficiency of resource use in health centers, and identifies possible areas for improvement and future analytical work to assess efficiency in resource use and allocation. The same efficiency analysis will be done for primary hospitals. Health posts will not be included in this type of analysis because cost estimates were not produced due to data quality concerns. The findings can contribute to the FMOH’s 5-year Health Sector and Transformation Plan, the second Growth and Transformation Plan, and improving advocacy towards more domestic resources for health – one of the goals under the National Health Care Financing Strategy.

Suggested Citation:
Table of Contents

Acknowledgements ................................................. 2
Foreword .............................................................. 2
Acronyms .............................................................. 4
Terms & Definitions .................................................. 5
Executive Summary .................................................. 7
1. Introduction ....................................................... 9
   How efficiency is defined ....................................... 10
   Purpose .......................................................... 10
2. Methods ............................................................ 11
   PHC cost study design .......................................... 11
   Efficiency analysis approach ................................. 11
3. Health Center Findings .......................................... 13
   Total health facility efficiency ............................... 13
   Department-level efficiency .................................. 15
   Input efficiency ................................................ 19
   Limitations of study .......................................... 26
4. Conclusions and Way Forward ................................ 27
References ........................................................... 29

List of Tables

Table 1. Technical and scale efficiency scores for health centers ........................................... 24
Table 2. Changes in inputs to make inefficient health centers efficient by urban and rural .............. 25

List of Figures

Fig. 1. Total health center expenditure in birr by outpatient equivalent visits .................................. 13
Fig. 2. Health center expenditure per outpatient equivalent visit in birr by total outpatient equivalent visits (no outliers) .................................................. 14
Fig. 3. Average per capita spending in birr for health centers by rural and urban area .................. 15
Fig. 4: Total expenditures in birr (excluding extreme values) and outputs by department for rural and urban health centers .................................................. 17
Fig. 5: Expenditures per output in birr (excluding extreme values) and total output by department for rural and urban health centers ........................................ 18
Fig. 6. Composition of volume of services (outpatient equivalents) provided at health centers ........ 19
Fig. 7. Clinical staff compared to total patients served (outpatient equivalent visits) for health centers by rural and urban areas ......................................... 20
Fig. 8. Clinical staff compared to per outpatient equivalent visit for health centers by rural and urban areas .............................................................. 21
Fig. 9. Range and composition of average output production ....................................................... 22
Acronyms

DEA  Data Envelopment Analysis
DEAP  Data Envelopment Analysis Program
DRS  Decreasing Returns to Scale
EFY  Ethiopian Fiscal Year
ETB  Ethiopian Birr
FMOH  Federal Democratic Republic of Ethiopia Ministry of Health
GDP  Gross Domestic Product
GTP  Growth and Transformation Plan
HEW  Health Extension Worker
HIV/AIDS  Human immunodeficiency virus and acquired immune deficiency syndrome
HR  Human Resource
HSDP  Health Sector Development Programme
HSTP  Health Sector Transformation Plan
IPD  Inpatient Department
IHME  Institute of Health Metrics and Evaluation
IRS  Increasing Returns to Scale
LB  Live birth
MCH  Maternal and Child Health
MDG  Millennium Development Goal
MOFEC  Ministry of Finance and Economic Cooperation
PHC  Primary Health Care
PHCU  Primary Health Care Unit
OPD  Outpatient Department
RTM  Resource Tracking and Management
SDG  Sustainable Development Goal
SPA+  Service Provision Assessment Plus
USAID  United States Agency for International Development
UHC  Universal Health Coverage
WHO  World Health Organization
**Terms & Definitions**

**Average:** The arithmetic average, which is the sum of all values for a specific variable divided by the total number of observations for that variable. This is prone to be influenced by extreme values due to potential outliers (very small or large values in the data that are not within the normal distribution).

**Efficiency:** An attribute of performance measured by examining the relationship between a specific product of the health care system (also called an output) and the financial value of the resources used to create that product (also called inputs). A primary health care facility would be efficient by maximizing output for a given set of inputs or to minimize inputs used to produce a given output.

**Outpatient Equivalent Visits:** Different patient visits scaled to be comparable outpatient visits. This captures the use of facility inputs to produce an inpatient discharge, maternal and child health visit, or delivery relative to production of an outpatient visit. The average cost per patient for outpatient, inpatient, maternal and child health, and delivery departments was used as a means to estimate outpatient equivalent weights.

One inpatient discharge = 2.78 outpatient visits  
One MCH visit = 1.04 outpatient visits  
One delivery = 3.71 outpatient visits

**Data Envelopment Analysis:** A non-parametric approach to measure technical efficiency. Efficiency scores (pure technical and scale) are estimated through the application of DEA for each health center, capturing a facility's relative resource use or inputs such as current staffing to produce care.

**Outpatient Department:** Curative services that do not require admission and provided in the outpatient department. Some outpatient treatments are provided in the Maternal and Child Health (MCH) department, but these were classified under the MCH department.

**Inpatient Department:** Provides procedures that require a patient to be admitted and have close monitoring during and after such procedure.

**Maternal and Child Health (MCH) Department:** Provides non-emergency maternal and child health services (such as immunizations or ante-natal care and some acute treatment), excluding deliveries.

**Delivery Department:** Provides basic obstetric care (health centers) and comprehensive obstetric care (primary hospitals), including pre-and post-delivery care.

**Cost:** Defined as the monetary value of non-capital, recurrent expenditures incurred and resources used to produce a defined set of health service outputs or to operate specific health facilities. The recurrent costs include drugs and supplies, salaries, and other operational costs (e.g., electricity, running water, maintenance, etc.), which are incurred on a regular basis that can be allocated as direct costs or indirect costs.

**Pure Technical Efficiency:** The minimum level of resources used for a unit of output. Wastage or inefficiencies occur when more resources than necessary are used to produce a level of output.

**Scale Efficiency:** Refers to the size and structure of a health provider, where a health facility might be too large (small) for its level of operation causing (in)efficiencies of scale.

**Unit Cost:** Total cost, or expenditure plus the value of resources used (e.g., in-kind or drugs and supplies consumed), incurred by a health facility or department to provide service for one patient.

**Primary health care unit (PHCU):** Encompasses primary health care facilities and related community-based activities. One unit is typically a primary hospital with five satellite health centers and each health center forms five satellite health posts, where the health posts are managerially and technically accountable to the health center.

**Woreda:** A district in Ethiopia that is the third or fourth administration level that typically encompasses 100,000 people. A PHCU is usually within one woreda.
**Primary Health Care Facilities in Ethiopia**

**Primary hospital:** A health facility within the PHCU that provides inpatient and ambulatory services this includes all services offered from health center as well as emergency surgical services, including Caesarean sections and blood transfusions. It is a referral center for health centers that reside within the primary hospital’s catchment area. This health facility typically has an average inpatient capacity of 35 beds and a staff of 53 people. Serves 60,000-100,000 people in a woreda. Investment in primary hospitals is still ongoing so not all PHCU’s are linked with primary hospitals and some primary hospitals may serve several woredas.

**Health center:** A health facility within the primary health care system that provides promotive, preventive, curative and rehabilitative outpatient care including basic laboratory and pharmacy services. This health facility typically has the capacity of 10 beds for emergency and delivery services. Health centers serves as a referral center for health posts, and provide supportive supervision for health extension workers (HEWs). Serves 15,000-25,000 people in a woreda.

**Health post:** A health facility within the primary health care system that mainly provides promotive and preventive health care services. A typical health post has two HEWs and they provide services in the health facility and in the community (often going house-to-house). Serves 3,000-5,000 in a woreda.

---

1 Description of primary health care facilities in Ethiopia adapted from FMOH (1) and Alebachew, Hatt, and Kukla (2).
Executive Summary

Ethiopia’s health sector over the last 20 years has seen unprecedented expansion particularly for its primary health care (PHC) system. The development of the health sector was made possible by strong political commitment, a substantial increase in domestic and external support, and rapid economic growth. Plans for continued investments in PHC include improvements in efficiency of resource use as it moves into a new transformational phase starting with the Health Sector Transformation Plan (HSTP) and second Growth and Transformation Plan (GTP II) from 2015/16-2019/20.

Significant resources are needed to achieve all of the health targets laid out in the HSTP and GTP II. A significant funding gap of 4.37 billion birr or 28% of the resources required to achieve the health targets set out in HSTP and GTP II was estimated for the next 5 years. Efficiencies in the health sector potentially free up resources to be used on the provision of quality health care, and help reduce the funding gap to achieve HSTP and GTP II targets.

Little evidence exists to document whether resources are used to maximize efficiency and productivity among PHC facilities or to identify factors determining poor or better health service performance in Ethiopia. One efficiency analysis of Ethiopia’s health posts found that only 25% of the sampled health posts (60 health posts) in Tigray region were found to be efficient in 2007/08. This report presents up-to-date evidence on efficient allocation and use of resources among 40 health centers across 2 big regions (Amhara and Oromia), 1 special support region (Benishangul-Gumuz), and 2 city administrations (Addis Ababa and Dire Dawa). This is the first round of efficiency analyses, where primary hospitals will be measured next. Health posts could not be included in such analyses because of major data limitations.

Cost efficiency is measured as the relationship between a specific product (output) and financial value of the resources used to create that product (inputs). A health center is efficient by minimizing inputs used to produce a given output or maximize output for a given set of inputs. The analysis in this report focuses on total health center efficiency, department-level efficiency, and input efficiency, where some health centers and departments appeared to be more efficient compared to others in terms of resource use relative to output, output production, and pure technical and scale efficiency.

Health center expenditures increased as the number of outpatient equivalent visits increased, but horizontal and vertical spreads indicate possible inefficiencies within the sampled health centers. Some health centers had high spending but low output. Other health centers appear to be more efficient with low levels of spending relative to output. It is evident that economies of scale occur as more people are accessing care from health centers, although this appears to hold true only across certain departments (OPD, delivery, and MCH for urban health centers only). This points to the need for increased focus on demand generation activities for this level of care as a mechanism to improve efficiency, and not solely on supply-side factors.

The provision of certain health services might be more cost effective among health centers compared to primary hospitals delivering the same service. For example, MCH department is about 150 birr less at health centers compared to primary hospitals. This accounts for about 42% of services provided at this point of care. Output production by skilled professionals remains very low in Ethiopia. The average number of outpatient equivalent visits per clinical staff per day is 3.7, compared to Kenya with an average 7 outpatient equivalent visits per medical staff per day and Ghana with 4 outpatient equivalent visits per medical staff per day in 2011. Ethiopian health centers studied were generously staffed, with a high average number of clinical staff of 26 compared to the minimum requirement of 12, pointing to a potential overstaffing problem relative to patient volume. This could be reasonable if the health system anticipates significant increases in demand in the future or is taking measures to make this happen, such as implementation of demand-side incentives or subsidies (such as health insurance schemes) or significant behavior change interventions. However, much of Ethiopia presents significant physical access and other demand-side constraints to service use, which may result in persistent inefficiencies in the use of staff resources and relatively high unit costs.
Data envelopment analysis (DEA) was used to estimate technical efficiency scores (pure technical efficiency and scale efficiency) for the 40 health centers. Efficiency scores range from 0 (completely inefficient) to 100% (efficient). Only 35% of the health centers were pure technically efficient for EFY 2006. The average pure technical efficiency score among the inefficient health centers is 79%, implying that on average, the inefficient health centers could reduce their inputs by 21% without reducing outputs. Only 10 health centers were scale efficient. The average scale efficiency score among the inefficient health centers was 82%, indicating a potential increase in total outputs by 18% within the existing health center capacity and size. An increase in outputs would reduce unit costs of service provision at health centers however this depends on the demand for health care services, which relies more on individual preferences to care, perceptions of quality, and accessibility – factors not necessarily within the control of a health provider. Almost fifty-six million birr would be the input cost savings (or 26% of total annual expenditure among studies health centers) if the 26 inefficient health centers became as efficient as the pure technically efficient health centers in the study, given current output levels. This breaks down to an input savings of 328 medical and 446 non-medical staff or 23.6 million birr in human resource expenditures, 21.7 million birr for drugs and supplies and over 10.5 million birr for indirect expenditures.

This analysis for health centers demonstrates some potential areas where improvements in resource allocation and use could lead to more efficient health service provision. Focusing on expanding some departments among health centers, along with encouraging patients to utilize lower level of primary care services, may lead to more optimal level of resource use. However, additional evidence on the most cost-effective health providers for certain primary care services is needed.

Caution should be exercised in drawing strong conclusions from simple efficiency measures. They do not control for some important confounders, such as difference in case mix and disease severity and also do not show why potential inefficiencies (or efficiencies) are occurring among the sampled health centers, and whether these are more widely prevalent. Identifying solutions to improve the efficiency of health centers is an important area where more analytical work is needed.

Producing further evidence that attempts to answer further questions around efficiency of primary care providers would provide the FMOH with the complete picture of cost efficiency and ways to improve it for a more efficient and equitable primary care system. Such work includes incorporating primary hospitals into analysis and triangulating studied health centers with the Service Provision Assessment Plus (SPA+) survey data, followed by site visits to health facilities that were found to be least and most efficient, to understand factors influencing findings.
1. Introduction

Universal health coverage (UHC) is the main goal for Ethiopia’s health sector in the coming decade, as it transitions to a middle-income (3). Primary health care (PHC) is considered the path or mechanism for Ethiopia to achieve UHC as outlined in the country’s 20-year health sector strategy, “Envisioning Ethiopia’s Path Towards Universal Health Coverage Through Primary Health Care”. This strategy outlines strategic areas of focus to ensure a quality and equitable health system that is sustainable, efficient, and adaptable to meet the health needs of a changing population between now and 2035. Continued strong investments into the PHC system (community, health posts, health centers, and primary hospitals) are anticipated to result in further health outcome improvements (3).

Ethiopia’s health sector over the last 20 years has seen unprecedented expansion particularly at the primary care level. Public health spending was biased towards hospitals and urban centers prior to 2005 (4). The Ethiopian government shifted this focus beginning with the implementation of the Health Extension Program, rapidly scaling up the construction of health posts from 4,211 in 2004/05 to 16,048 by 2012/13 (5,6) and deployment of frontline cadre of health workers to provide preventive and promotive health services. This has been met with continued expansion of the health centers and introduction of new level of care within the primary health care unit (PHCU), primary hospitals, requiring an influx of financial and human resources. A “flooding” policy was instituted during the past 20 years under the Health Sector Development Programme (HSDP) phase to address shortages of essential health workforce in the country, along with rapid expansion of hospitals and health centers.

The development of the health sector was made possible by strong political commitment, a substantial increase in external support, and rapid economic growth (7). Public health expenditure almost doubled from 1995-20111 (constant 2012 $US dollars). The growth in gross domestic product (GDP) was one of the fastest growing economies with an average of 9% real growth in GDP from 1999-2012 (8). This allowed for the tripling of the overall government budget (constant 2010 prices) during the same timeframe and in turn more resource for health2. External resources also increased from $US6 million to $US836 million (constant 2012 $US dollars) from 1995 to 2011 (7). This continued external support was critical for the health sector development, especially primary care with half of primary care expenditures coming from external resources in 2011 (9). The increased focus on health from global partners was partially due to the Millennium Development Goal (MDG) agreement (7,10). This pushed the global agenda for more targeted focus towards the eradication of poverty and hunger, improvement of maternal and child health outcomes, equality and women empowerment, universal primary education, ensure environmental sustainability, and combat major disease such as malaria and HIV/AIDS (http://www.unmillenniumproject.org/goals/gti.htm). During this time the global community mobilized efforts, including financing programs to achieve core targets, toward these common goals. The Sustainable Development Goals (SDGs) have brought in even more priorities to the global arena (MGDs: 8 goals and 18 targets versus SDGs: 17 goals and 169 targets). These goals are competing priorities for the ever-dwindling pool of resources from the global community and governments focusing on achieving such targets by 2030. Additionally, decision-makers are increasingly faced with growing demand for health care services and available resources alongside competing priorities from other sectors.

Plans for continued investments in PHC include improvements in efficiency of resource use as it moves into a new transformational phase starting with the Health Sector Transformation Plan (HSTP). Over the next five years (2015/16-2019/20) Ethiopia plans to achieve UHC by expanding PHC coverage to everyone through improved access to quality basic curative and preventative health care services and strengthening implementation of the nutrition program (3,11). Significant resources are needed to achieve all of the health targets laid out in the HSTP and second Growth and Transformation Plan (2015/16-2019/20) (GTP II) such as reducing maternal mortality ratio from 420 per 100,000 live births (LBs) in 2014/15 to 199 per 100,000 LBs by 2019/20 and reducing under-5 child mortality from 64 per 1,000 LBs in 2014/15 to 30 per 1,000 LBs by 2019/20 (3,11). A funding gap of 4.37 billion birr or 28% of the resources required

1 Authors calculations using data collated from the National Health Accounts from 1995-2011 for Ethiopia from Mann C, Ng C, Akseer N, et al. (7).
2 Authors calculations using Ministry of Finance and Economic Cooperation (MOFEC) audited data from National Accounts (40)
1. Introduction

is determined based on estimates of resources needed to achieve the health targets set out in HSTP and GTP II and resources available over the next 5 years. Efficiencies in the health sector potentially free up even more resources to be used on the provision of quality health care, and one of the five ways to generate fiscal space for health (41). More efficient resource allocation and use was one of the main focus areas for the Health Care and Financing Strategy (1998-2015), although issues still remained around health facilities utilizing resources efficiently during this time (8). Improved resource efficiency continues to be emphasized in Ethiopia’s National Health Financing Strategy (2015-2035), and delivering health care that maximizes resource use and avoids waste is one of the dimensions of quality highlighted in HSTP’s strategic theme around “Excellence in quality improvement and assurance” (3).

Caution should be exercised in drawing strong conclusions from simple efficiency measures. They do not control for some important confounders, such as difference in case mix and disease severity and also do not show why potential inefficiencies (or efficiencies) are occurring among the sampled health centers, and whether these are more widely prevalent. Identifying solutions to improve the efficiency of health centers is an important area where more analytical work is needed.

How efficiency is defined

For this study we have used the concept of cost efficiency as our definition of efficiency. This is an attribute of performance that is measured by examining the relationship between a specific product of the health care system (also called an output) and the financial value of the resources used to create that product (also called inputs). Based on this definition, a health center would be efficient by minimizing inputs used to produce a given output or maximize output for a given set of inputs.

Purpose

Little evidence exists to document whether resources are used to maximize efficiency and productivity among PHC facilities, or identifying factors influencing poor or better health service performance, in Ethiopia. Efficiency analyses of Ethiopia’s health system have occurred mostly at a global level, comparing relative efficiency across multiple countries (12)(13). For example, one health system analysis in 2007 found Ethiopia to be globally efficient using Data Envelopment Analysis across 180 countries categorized by the WHO economic development status (12). On the other hand, another study found Ethiopia’s health system to be one of the lowest ranked countries for efficiency (169 out of 191 countries) using a non-deterministic frontier production function analysis (14). One efficiency analysis on Ethiopia’s primary care system was found in the literature but limited to estimating the efficiency of select health posts in Tigray region. This study found that in 2007/08 75% of the health posts could increase the number of preventative and curative activities given the current resources and outputs produced, while most of the health posts were at the optimal size suggesting the number of staff were enough at that point in time (15).

This report presents a preliminary analysis providing the Federal Democratic Republic of Ministry of Health (FMOH) evidence to assess the degree that some PHC facilities are less “efficient” compared to others and showcasing possible factors for the findings. It determines which health centers are relatively inefficient compared to others, areas where the inefficient health centers could become more efficient by maximizing resource use through either reduction of inputs given the level of output or increase output given the levels of inputs, and future analytical work to guide more efficient resource allocation and use that ultimately frees up more resources to provide quality essential health care. The same methods and analysis will be applied to primary hospitals once data is available. Health posts data was very limited and could not be included in this type of analysis at this time.
2. Methods

Under this section we review the study design of the PHC cost study that provides the data used for the efficiency analysis, the approach used to measure efficiency, and the limitations of data sources and approached used to measure efficiency.

PHC cost study design

Data on the costs or resources used to provide services at PHC facilities (primary hospitals, health centers, and health posts) was obtained from the PHC cost study conducted by the Resource Tracking and Management (RTM) project and FMOH (16). The PHC cost study was retrospective. All inputs and outputs were measured for one full year: Ethiopian fiscal year (EFY) 2006 (Gregorian calendar 2013/14) for health centers to avoid any cost distortions related to seasonal effects. A total of 40 health centers were included in the analysis, and were sampled from 2 city administrations (Addis Ababa and Dire Dawa), 2 big regions (Amhara and Oromia), and 1 special support region (Benishangul-Gumuz). Health center departments or cost centers are inpatient department (IPD), outpatient department (OPD), maternal and child health (MCH) department, and delivery department. Inpatient care consists of procedures that require a patient to be admitted, and have close monitoring during and after such procedure. Outpatient care consists of providing curative services that do not require admission and exclude maternal and child health (MCH) specific services because these were classified under the MCH department. Services provided in the MCH department comprise of non-emergency maternal and child health services (such as immunizations or ante-natal care), excluding deliveries. The delivery department provides basic obstetric care (health centers) and comprehensive obstetric care (primary hospitals), including pre-and post-delivery care. This study does not include the change in unit costs over time due to changes in salary increases, drugs costs, and service provision since the data is collected for specified period of time.

Secondary data was extracted from health facilities and other related health and financial administrative institutions, pulling from health utilization (drug consumption, utilization rates, etc.), financial, and administrative records (e.g., formal staff assignments, job descriptions, etc.). A top-down costing framework was used to estimate total and unit costs by departments (inpatient, outpatient, maternal and child health, and deliveries) and health facilities. Refer to Berman, Alebachew, Mann, Agarwal, and Abdella (16) for further details on the methods and final outputs for this costing approach.

Efficiency analysis approach

Cost efficiency is examined in three ways: 1) total health facility efficiency; 2) cost center or department-level efficiency; and 3) input efficiency. The main research questions for this efficiency analysis of health centers are:

- Is there a relationship between total facility and department level spending (inputs) and number of outpatient equivalent visits (outputs)?
- How effectively are resources being translated into services and what is the right mix of inputs given a level of outputs that would make a health facility more efficient compared others?
- Do health centers have the absorptive capacity for an increase in health service demand? This last question is of particular importance given the roll out of the community-based health insurance scheme across the country and the soon-to-be implemented social health insurance.

One problem that often affects analysis of efficiency for multi-function health facilities is the heterogeneity of outputs – health centers and hospitals provide an array of different services. In our previous report calculating unit costs, we simply added together the different outputs for each department, not accounting for the value of inputs to produce different outputs, a limitation clearly stated in the paper (16). In similar work done by the Institute for Health Metrics and Evaluation (IHME), they estimated outpatient equivalents for public health facilities in Ghana by weighting different types of outputs. For example, on average one inpatient bed-day equated to 3.8 outpatient equivalent visits,
while one birth equated to 10.9 outpatient visits (17).

In this report the average cost per patient served by department was used to estimate the weights applied to generate outpatient equivalent visits for health centers. The average cost per patient for OPD, IPD, MCH, and delivery departments among health centers were 208 Ethiopian birr (ETB), 579 ETB, 216 ETB, and 772 ETB per patient, respectively (16). It was estimated that one inpatient discharge equates to 2.78 outpatient visits, one MCH visit is 1.04 outpatient visits, and a delivery equals 3.71 outpatient visits. Outpatient equivalent visits were used as the output for the total health facility efficiency analysis along with the Data Envelopment Analysis (DEA). The department-level efficiency analysis used the unweighted outputs.

Results are presented for both rural and urban health centers. Rural centers are those in rural locations of either agrarian or pastoral regions including the big regions (Amhara and Oromia) and development regional state (Benishangul-Gumuz). Urban health centers are located in the two city administrations of Addis Ababa and Dire Dawa. Details on sample selection can be found in the earlier report (16).

Health facility efficiency is compared across health centers through a series of graphs based on different measures of inputs and outputs. This is done both for the whole health center and across departments that exist within health centers. Total health facility efficiency examines the relationship between total expenditure and total output through a series of scatter plots and graphing per capita health spending disaggregated by rural and urban areas. Departmental efficiency assesses variations of expenditure and output by department for both rural and urban areas, composition of volume of services by department, and assess potential cost advantages of delivering certain health care services in health centers versus primary hospitals or vice versa.

Input efficiency explores human resource (HR) productivity and technical efficiency. Human resource productivity is assessed by measuring the relationship between clinical staff and health center outputs along with the range and composition of output production for clinical staff. Technical efficiency, consisting of pure technical efficiency and scale efficiency, is measured by using a non-parametric analytical technique known as Data Envelopment Analysis (DEA). A health facility is pure technically efficient when the minimum level of resources is used (inputs) for a unit of output (18,19). Wastage or inefficiencies occur when more resources than necessary are used to produce a level of output. Scale efficiency refers to the size and structure of the health center, where a health center might be too large or small for its level of operation causing inefficiencies of scale (18)(19). Service provision or output for the DEA model is defined into outpatient equivalent visits for four departments: inpatient discharges, outpatient visits, MCH visits, and deliveries. The inputs in the model consist of clinical (e.g., health officers, nurses, midwives) and non-clinical staff (e.g., janitorial staff, data and finance managers, pharmacists, etc.), HR expenditures, drugs and supplies expenditures, and indirect expenditures such as electricity and running water. This estimation is relative to the other health centers in the study rather than the optimal mix of inputs and outputs for all health centers in Ethiopia. It is possible that health centers deemed more efficient might have higher utilization rates compared to others due to other factors such as close proximity to an urban center, better quality of services, and so on.

Another efficiency analysis approach is measuring whether a health facility is allocatively efficient or if inputs are used in optimal proportion given prices in order to minimize production cost for a given output (15,18,20). This report only focuses on technical efficiency of health centers.

Both Stata and Microsoft Excel are used to make all graphs presented in this report. The Data Envelopment Analysis program (DEAP) Version 2.1 designed by Coelli (21) is used for the DEA to estimate the technical efficiency scores for an input-based model.
3. Health Center Findings

Ethiopia’s PHC system consists of three levels of facilities – health posts, health centers, and primary hospitals, which comprise the primary health care unit (PHCU). This analysis is focused on health centers. A separate report is being finalized on primary hospitals. Health posts are a critical entry point of care for the PHCU however including this facility type in the analysis proved difficult due to significant data gaps in record keeping, discussed in more detail in Berman et al (16).

**Total health facility efficiency**

We examined health center expenditure relative to its respective output. Here we can learn the extent to which financial and real inputs (e.g., total funds or number of staff in a facility) are related to the total output or volume of patients served.

Fig. 1 graphs total expenditure with total patient volume calculated in outpatient equivalents for both urban and rural health centers in the PHC cost study. Each observation is color-coded by regional state. The solid black line is based on a two-variable regression that models the relationship between expenditure and output within the sampled health centers. All health centers above this line are spending more per outpatient equivalent patient compared to those that are either on or below it. The health centers in the study are closely fitted to the line, indicating a close relationship between money and output, especially among urban health centers. Most of the rural health centers are below this line, likely caused by an extreme value for one health center in Benishangul-Gumuz with very high expenditures relative to outpatient equivalent visits.

**Fig. 1. Total health center expenditure in birr by outpatient equivalent visits**
A majority of the urban health centers have higher expenditures compared to the more rural health center with the same level of patients served. Health centers in urban areas also have more patients served than health centers located in rural areas. A wide range of patients served is apparent for some health centers but with the same or similar level of spending. Inefficiencies in resource use might be attributed to these horizontal and vertical spreads in the data. Health centers with high levels of output relative to total spending might appear to be the most efficient but this depiction of the relationship between expenditure and output does not capture whether quality services are provided among these health facilities.

We expect as patient volume (output) increases, the cost per patient would decrease, indicating economies of scale for health centers. Fig. 2 demonstrates a decrease in cost per patient for both rural and urban health centers (one outlier for cost per contact from Benishangul-Gumuz was excluded). The cost advantage is more prominent among urban health centers, while rural health centers indicate a high variability of costs per outpatient equivalent visits for similar output levels.

**Fig. 2. Health center expenditure per outpatient equivalent visit in birr by total outpatient equivalent visits (no outliers)**

Equity is one of the core goals for the HSTP (2015/16-2019/20). This includes, but not limited to, reducing barriers to health care access in terms of lack of income to pay for health services, inconvenient working hours of health facilities, and physical access (3); most of which are demand-side equity issues. Equity improvements could also be made on the supply-side with more equitable resource allocation for health care providers. We assess a relatively crude estimate of equitable resource allocation with the average per capita spending (in birr) for health centers by geographic area (Fig. 3). The major urban areas (Addis Ababa and Dire Dawa) are spending more per person covered compared to those health centers located in more rural areas. This might be due to a higher number of average clinical staff among urban health centers (42) compared to rural health centers (14). On the other hand, this possible difference in resources per

---

1 The per capita or person health spending was estimated by dividing total health center expenditure by the catchment population.
person covered may be due to the higher service volumes. For urban health centers, the average contact rate is 1.24 contacts per person covered per year, while among rural health centers this was 0.66. Higher utilization of urban public health facilities means greater consumption of drugs and supplies per person, which is a main cost driver for health centers (16). The additional resources spent per person among urban health centers may have also come from the retained revenue from user fees due to higher patient volume given catchment population. Nonetheless, substantially fewer resources are being spent per person, on average, in rural areas (88 ETB) compared to urban (184 ETB). This is explored further under the Input Efficiency section.

**Fig. 3. Average per capita spending in birr for health centers by rural and urban area**

Note: Per capita spending is based on the reported catchment population from the health centers where total health center expenditure was divided by catchment population. One health center is not included in this estimate because catchment population was not known.

### Department-level efficiency

Varying degrees of differences in input-output ratios are present when looking more closely at the department level for health centers. Fig. 4 shows the graphs displaying total expenditures (excluding extreme values4) in birr and outputs by department for both rural and urban health centers.

IPD spending does not necessarily increase as IPD discharges increase among rural health centers – indicating potentially little effect on total spending of costs associated with higher volumes for inpatient care. A more linear relationship is apparent for urban health centers, where total expenditure for IPD increases with IPD discharges. Some health centers, in both geographical settings, experience high level of spending but low volume of discharges (top left-hand side of the graphs). This indicates possible overstaffing of the inpatient department relative to volume and/or possible leakages or over-prescribing of drugs and supplies in this department. Further exploration into these extreme cases would uncover potential factors influencing these findings.

An increasing relationship is present for outpatient spending and patient volume, more specifically among urban health centers. Although some health centers have a high level of spending relative to volume (e.g., Benishangul-Gumuz) indicating potential inefficiencies. Rural health centers have a substantially low level of outpatient visits and total spending.

---

4 One extreme value for IPD, OPD, and Delivery expenditures was found; in order to display the trend between expenditures and outputs more clearly these values were excluded from the graphs depicted in Fig. 4. No extreme values for MCH expenditures exist for health centers.
The MCH department also experienced an increasing relationship between expenditures and outputs. However, potential inefficiencies are evident with health centers with the same volume of MCH visits but a large difference in expenditures (horizontal spread) or health centers with the same level of spending but differences in the number of MCH visits (vertical spread).

The spending in Delivery departments in rural health centers is relatively flat, regardless of number of deliveries. Similar to IPD, inefficiencies might be occurring among this department for rural health centers with more human resources allocated than need (low number of deliveries). Among urban health centers, an increasing relationship is more apparent between total spending and deliveries although some health centers are spending more per delivery - those above the black line - compared to those that are on or below the black line. Potential inefficiencies and identifying where efficiency gains could be made is explored in more detail under the Input Efficiency section of this report.

As previously stated, we would expect a decreasing relationship between expenditures per patient as the number of outputs increases – demonstrating economies of scale. Fig. 5 shows that some departments see a decrease in spending per contact as output increases. Some of the departments estimated expenditure per patient had extreme values, which were excluded in the graphs to avoid masking the linear relationship being examined. These outliers consisted of four health centers for IPD, one for OPD, three for MCH, and two for delivery (16).

For IPD, the linear relationship is not very discernable and the fitted line is with a wide spread for both rural and urban areas. For OPD, there is a clearer decreasing relationship between expenditures per visit and total outpatient visits. This indicates OPD within health centers become more cost efficient as utilization increases. There is also a clearer relationship for expenditures per MCH visit and MCH visits. This is more prominent among urban health centers, where the expenditures per MCH visit declines as more patients are served within this department. A similar case is true for the Delivery department as well, although health centers are more spread out around the linear fit for those located in urban areas. For example, two health centers have the same number of deliveries for EFY 2006 (1,000) but the average cost per delivery is very different with one being less than 500 ETB and the other being slightly more than 2,000 ETB. Both health centers are based in Addis Ababa where we would expect a similar unit cost. Perhaps, the high unit cost health center could make some changes to improve the efficient use of resources per delivery or it might be providing better quality delivery services, and thus costing more per delivery, compared to the lower unit cost health center. Such cases would be good to investigate the factors influencing these findings.
Fig. 4: Total expenditures in birr (excluding extreme values) and outputs by department for rural and urban health centers
Fig 5: Expenditures per output in birr (excluding extreme values) and total output by department for rural and urban health centers.

Inpatient Department

- Rural
- Urban

Outpatient Department

- Rural
- Urban

Maternal and Child Health Department

- Rural
- Urban

Delivery Department

- Rural
- Urban
The removal of the extreme values of unit cost for the department-level analysis allowed us to identify whether economies of scale are present among health centers that were not anomalies in the data. Nonetheless, such values should be examined further, rather than ignored, to determine the causes of such high unit costs, whether it be extremely low utilization by department but high costs (such as over staffing while very few are uses services from that department), potential leakages or wastage of health spending by department, or an error in record keeping (over-reporting expenditures or under-reporting utilization).

The provision of certain health services might be more cost efficient among health centers compared to primary hospitals delivering the same service. (Differences in cost-effectiveness would depend on controlling for both quality and patient need). The cost per inpatient discharge is substantially lower among health centers (579 birr) compared to primary hospitals (807 birr). MCH department is about 150 birr less at health centers compared to primary hospitals. The difference of OPD unit costs between health centers and primary hospitals is marginal at 208 ETB and 223 ETB, respectively. (Note: Cost per type of visit reported is not based on outpatient equivalent visits.) Fig. 6 shows the composition of service outputs averaged across all studied health centers (total) and by region, which could also explain some of the overall expenditure differences. For example, MCH services account for an average of 42% of services provided among the studied health centers. Focusing on expanding some departments in health centers, along with encouraging patients to utilize lower level of primary care services, may lead to more optimal resource use within the PHCU. More analytical work is needed before such actions are taken.

**Fig. 6. Composition of volume of services (outpatient equivalents) provided at health centers**

![Bar chart showing the composition of volume of services provided at health centers by region.](Image)

**Input efficiency**

We explore input efficiency for health centers by relating human resource levels in facilities to measures of output to provide estimates of human resource productivity and technical efficiency.

---

5 Further detail of unit cost estimates for PHC providers is available at Berman et al (16).
Staffing a health center with clinical staff, or individuals that provide primary care services directly to patients, is mostly determined by government norms and not determined much by patient load. FMOH has set a minimum staffing requirement for health centers to follow. This requirement states that health centers should have at least 12 medical professionals (health officers, midwives, and nurses) (1). On average, the sampled health centers have 26 clinical staff, substantially higher than the minimum requirement. Referring to Fig. 7, health centers above the black line have more clinical staff per patient relative to the facility volume of outpatient equivalents compared to health centers that are either on or below it. Health centers located in pastoral settings tend to have a higher number of clinical staff relative to volume of patients served compared to other rural health centers. In urban areas, health centers located in Addis Ababa have a higher number of clinical staff relative to total patient volume. These two findings highlight a potential overstaffing problem relative to volume, thus creating differences in the productivity of human resources in producing health outputs. This becomes even more evident once the health centers catchment population relative to output is included (Fig. 8), especially in urban areas. Health centers in Dire Dawa have substantially fewer clinical staff compared to those in Addis Ababa with the same per contact rate (total output over catchment population).
We explore health staff productivity by assessing the composition of the number of outpatient equivalent visits experienced by each health center’s clinical staff per day (Fig. 9). The average number of outpatient equivalent visits per clinical staff per day is 3.7. This ranges from 1.1 to 7.2, where Amhara had the highest average number of visits per clinical staff per day while Benishangul-Gumuz had the lowest. Overall these levels of productivity are quite low reflecting an imbalance between service capacity (represented by clinical staffing) and service demand. These inter- and intra-regional disparities imply potential over staffing relative to patient volume. When aggregated by major urban centers and rural areas, we find that the average output production is lower among urban health centers versus rural ones in this study. Among urban health centers the average outpatient equivalent visits per clinical staff per day is 3, while for rural health centers this was 4. This implies that urban health centers are even more inefficient for output production relative to clinical staff compared to rural health centers.
Global reports identify significant health workforce shortages when assessing density of key clinical staff (e.g., ratio of physicians per 10000 population), especially among Sub-Saharan African countries (22,23). The density per 10000 population for skilled professionals in 2010 for Ethiopia, Kenya, and Ghana was 2.7, 9.9, and 13.6, respectively (22). These most recent estimates of skilled professionals are significantly below three identified health workforce thresholds of 22.8 per 10000 population from the World Health Report 2006; 34.5 skilled professionals per 10000 population International Labour Organization in support of its regulation on Social Protection, the World Social Security Statistics 2010/2011, and a background paper for The World Health Report 2010; and a target of 59.4 skilled professionals per 10000 population, estimated by the World Health Organization (WHO) and United States Agency for International Development (USAID) for the Ending Preventable Maternal Deaths initiative, to reduce global maternal deaths to 50 per 100000 live births by 2035 (22). Although the average skilled professional numbers per population for Ethiopia reported are low (2.7 per 10000) in our sample of health centers we found an average of 8.2 per 10000 ranging from 2.6 to 18.4.

Despite claims of significant health workforce shortages, output production of skilled professionals remains extremely low, as shown for Ethiopia. Kenya had an average of 7 outpatient equivalent visits per medical staff per day, while in Ghana it was 4 outpatient equivalent visits per medical staff per day in 2011 (17,24). Low output production could be reasonable if the health system anticipates significant increases in demand in the future, and taking measures to make this happen, such as implementation of health insurance schemes. Or inefficiencies in the use of resources to deliver services could be attributing to the relatively high unit costs.

**Technical efficiency (potential resource equivalents gained)**

As explained under the Methods section, we used DEA to estimate the gap between actual and relative efficient resource use in the health centers studied. This type of analysis has been widely used to determine the relative efficiency of both public and private health care providers in Sub-Saharan Africa. In Kenya, 56% of public health centers were found to be technically inefficient, with an average 35% reduction of inputs could be reduced without reducing outputs and outputs could increase by 30% under the current capacity and size of the health centers (25). Several studies in Ghana found varying degrees of inefficiencies for different levels of public and private health care providers (17,19,26). In 2001, DEA was used to show that only 30% of public primary health clinics in South African Province of KwaZulu-Natal were technically efficient (27). Health centers in Burkina Faso were found to be relatively efficient, where the technically inefficient health centers could only reduce inputs by 9% without decreasing outputs while on the other hand they could only increase outputs, on average, by 3% without expanding the size and capacity of the health centers.
More than half of the studies 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 (29).

Only one DEA study was found for Ethiopia’s health system focusing on government-run health posts in Tigray region. Among the 60 health posts studied, 70% and 30% were found to be pure technically and scale inefficient, respectively (15). The average technical efficiency score among the inefficient health posts was 42%, meaning that 58% of the inputs could be reduced while maintaining the same level of output. The average scale efficiency score among the inefficient health posts was 90%, or outputs could increase only by 10% given the current capacity (size and structure) of the health posts. However, it is possible that it may not account for all services provided outside of the health post. One recent study found that health extension workers spend, on average, 43% of their time providing services at the health post, with the remaining time delivering services in the community and travel time to households along with other work-related non-service delivery activities such as attending trainings and meetings (30).

We estimated efficiency scores (technical and scale) through the application of DEA for each health center, capturing a facility’s resource use or inputs such as current staffing to produce care (17). The estimated technical and scale efficiency scores for the sampled health centers are shown in Table 1. Efficiency scores range from 0 (completely inefficient) to 100% (efficient). Fourteen out of 40 (35%) health centers were technically efficient, while the remaining 26 (65%) were technically inefficient for Ethiopian fiscal year (EFY) 2006. The average technical efficiency score among the inefficient health centers is 79%. This implies that, on average, the inefficient health centers could reduce their inputs by 21% without reducing outputs. Only 10 out of 40 health centers were scale efficient, while 30 were scale inefficient. The average scale efficiency score among inefficient health centers is 82%, inferring a potential to increase total outputs by 18% within the existing capacity and size. An increase in outputs would reduce unit costs of service provision at health centers however this depends on the demand for health care services, which relies more on individual preferences to care, perceptions of quality, and accessibility – factors not necessarily within the control of a health provider. Another option would be to find cost savings by reducing inputs among inefficient health centers.

Table 2 highlights the input reductions needed to make the 26 inefficient health centers as efficient as the most technically efficient health centers in this study given current output levels. This implies that input reductions could save a total of 55.77 million birr (26% of total annual expenditure among studies health centers) for the study year without any reduction in output. This breaks down to an input savings of 328 medical and 446 non-medical staff or 23.56 million birr in human resource expenditures, 21.67 million birr for drugs and supplies and 10.5 million birr for indirect expenditures. The input savings for rural health centers is 5.5 million birr or 9.3% of the total rural health center expenditures in the analysis. This cost saving consists of a reduction in 24 clinical and 49 non-clinical staff or 2.26 million birr in human resources, as well as 1.5 million birr for drugs and supplies, and 1.7 million birr for indirect costs. The input savings for urban health centers is substantially more than the rural health centers with 50.26 million birr or 38.6% of the total urban health center expenditures in the analysis. This accounts for a reduction in 304 clinical staff and 397 non-clinical staff or 21.3 million birr in HR spending, along with 20.1 million birr for drugs and supplies and 8.8 million birr for indirect spending.

---

6 A health post in Ethiopia is typically staffed with 2 front-line health workers known as health extension workers (HEWs). Services provided at this level are mostly preventative services and some basic curative health care services (e.g., immunizations).
<table>
<thead>
<tr>
<th>Health Centers</th>
<th>Technical Efficiency Score (%)</th>
<th>Scale Efficiency Score (%)</th>
<th>Returns to scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meka Health Center</td>
<td>1.00</td>
<td>1.00</td>
<td>-</td>
</tr>
<tr>
<td>Dobat Health Center</td>
<td>0.46</td>
<td>0.99</td>
<td>irs</td>
</tr>
<tr>
<td>Aykel Health Center</td>
<td>1.00</td>
<td>1.00</td>
<td>-</td>
</tr>
<tr>
<td>Genda Wuha Health Center</td>
<td>1.00</td>
<td>1.00</td>
<td>-</td>
</tr>
<tr>
<td>Debark Health Center</td>
<td>0.80</td>
<td>0.97</td>
<td>irs</td>
</tr>
<tr>
<td>Ambagioiorgis Health Center</td>
<td>0.87</td>
<td>1.00</td>
<td>irs</td>
</tr>
<tr>
<td>Awunt Health Center</td>
<td>1.00</td>
<td>1.00</td>
<td>-</td>
</tr>
<tr>
<td>Jiga Health Center</td>
<td>0.93</td>
<td>0.98</td>
<td>irs</td>
</tr>
<tr>
<td>Mankusa Health Center</td>
<td>0.91</td>
<td>0.90</td>
<td>irs</td>
</tr>
<tr>
<td>Doro Damisa Health Center</td>
<td>1.00</td>
<td>0.52</td>
<td>irs</td>
</tr>
<tr>
<td>Qereta Health Center</td>
<td>1.00</td>
<td>0.68</td>
<td>irs</td>
</tr>
<tr>
<td>Amuna Yambel Health Center</td>
<td>1.00</td>
<td>0.32</td>
<td>irs</td>
</tr>
<tr>
<td>Abaeba Health Center</td>
<td>1.00</td>
<td>0.27</td>
<td>irs</td>
</tr>
<tr>
<td>Gori Health Center</td>
<td>1.00</td>
<td>1.00</td>
<td>-</td>
</tr>
<tr>
<td>Golegota Health Center</td>
<td>1.00</td>
<td>0.91</td>
<td>irs</td>
</tr>
<tr>
<td>Birity Health Center</td>
<td>0.84</td>
<td>0.55</td>
<td>irs</td>
</tr>
<tr>
<td>Amoraw Health Center</td>
<td>0.51</td>
<td>0.78</td>
<td>drs</td>
</tr>
<tr>
<td>Abomsa Health Center</td>
<td>1.00</td>
<td>1.00</td>
<td>-</td>
</tr>
<tr>
<td>Angada Health Center</td>
<td>0.90</td>
<td>0.44</td>
<td>irs</td>
</tr>
<tr>
<td>Dire Dawa Health Center</td>
<td>0.26</td>
<td>0.77</td>
<td>irs</td>
</tr>
<tr>
<td>Goro Health Center</td>
<td>0.69</td>
<td>0.94</td>
<td>drs</td>
</tr>
<tr>
<td>Gendegerada Health Center</td>
<td>0.59</td>
<td>0.98</td>
<td>irs</td>
</tr>
<tr>
<td>Legehare Health Center</td>
<td>0.97</td>
<td>0.75</td>
<td>drs</td>
</tr>
<tr>
<td>Biyoawale Health Center</td>
<td>0.63</td>
<td>0.94</td>
<td>irs</td>
</tr>
<tr>
<td>Melkojeddu Health Center</td>
<td>0.45</td>
<td>1.00</td>
<td>irs</td>
</tr>
<tr>
<td>Addis Ketema Health Center</td>
<td>0.65</td>
<td>0.81</td>
<td>drs</td>
</tr>
<tr>
<td>Gendekore Health Center</td>
<td>0.56</td>
<td>0.96</td>
<td>drs</td>
</tr>
<tr>
<td>Berber Health Center</td>
<td>0.65</td>
<td>0.90</td>
<td>irs</td>
</tr>
<tr>
<td>Galisa Health Center</td>
<td>0.74</td>
<td>0.74</td>
<td>irs</td>
</tr>
<tr>
<td>Dibate Health Center</td>
<td>0.59</td>
<td>0.92</td>
<td>drs</td>
</tr>
<tr>
<td>Abramo Health Center</td>
<td>1.00</td>
<td>1.00</td>
<td>-</td>
</tr>
<tr>
<td>Bambasi Health Center</td>
<td>0.35</td>
<td>0.94</td>
<td>irs</td>
</tr>
<tr>
<td>Goro Health Center</td>
<td>1.00</td>
<td>1.00</td>
<td>-</td>
</tr>
<tr>
<td>Bole 17 Health Center</td>
<td>1.00</td>
<td>0.65</td>
<td>drs</td>
</tr>
<tr>
<td>Kirkos Health Center</td>
<td>0.70</td>
<td>0.66</td>
<td>drs</td>
</tr>
<tr>
<td>Hiwot Amba Health Center</td>
<td>0.73</td>
<td>0.86</td>
<td>drs</td>
</tr>
<tr>
<td>Meshualekia Health Center</td>
<td>0.87</td>
<td>0.72</td>
<td>drs</td>
</tr>
<tr>
<td>Kebena Health Center</td>
<td>0.67</td>
<td>0.64</td>
<td>drs</td>
</tr>
<tr>
<td>Semien Health Center</td>
<td>0.77</td>
<td>0.60</td>
<td>drs</td>
</tr>
<tr>
<td>Arada Health Center</td>
<td>0.56</td>
<td>0.74</td>
<td>drs</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>0.79</strong></td>
<td><strong>0.82</strong></td>
<td></td>
</tr>
</tbody>
</table>

drs = decreasing returns to scale  
irs = increasing returns to scale
Table 2. Changes in inputs to make inefficient health centers efficient by urban and rural

<table>
<thead>
<tr>
<th>#</th>
<th>Inefficient Health Centers</th>
<th>Technical Efficiency Score (%)</th>
<th>HR Costs</th>
<th>Drugs and Supplies Costs</th>
<th>Indirect Costs</th>
<th>Medical Staff</th>
<th>Non-Medical Staff</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dabat</td>
<td>0.46</td>
<td>824,690</td>
<td>1,119,115</td>
<td>117,909</td>
<td>16</td>
<td>15.718</td>
</tr>
<tr>
<td>2</td>
<td>Ambagiorgis</td>
<td>0.87</td>
<td>144,770</td>
<td>507,137</td>
<td>13,610</td>
<td>8</td>
<td>6.33</td>
</tr>
<tr>
<td>3</td>
<td>Amoraw</td>
<td>0.51</td>
<td>1,559,975</td>
<td>1,349,178</td>
<td>373,863</td>
<td>29</td>
<td>39.079</td>
</tr>
<tr>
<td>4</td>
<td>Dire Dawa</td>
<td>0.26</td>
<td>1,367,938</td>
<td>1,839,503</td>
<td>794,363</td>
<td>25</td>
<td>26.075</td>
</tr>
<tr>
<td>5</td>
<td>Goro</td>
<td>0.69</td>
<td>550,198</td>
<td>516,683</td>
<td>1,480,660</td>
<td>8</td>
<td>11.638</td>
</tr>
<tr>
<td>6</td>
<td>Gendegerada</td>
<td>0.59</td>
<td>1,045,684</td>
<td>1,051,053</td>
<td>748,184</td>
<td>8</td>
<td>10.869</td>
</tr>
<tr>
<td>7</td>
<td>Legehares</td>
<td>0.97</td>
<td>1,344,287</td>
<td>116,512</td>
<td>798,814</td>
<td>3</td>
<td>1.088</td>
</tr>
<tr>
<td>8</td>
<td>Melkajeldu</td>
<td>0.45</td>
<td>1,032,079</td>
<td>942,011</td>
<td>1,073,598</td>
<td>16</td>
<td>17.696</td>
</tr>
<tr>
<td>9</td>
<td>Addis Ketema</td>
<td>0.65</td>
<td>1,808,034</td>
<td>922,295</td>
<td>479,223</td>
<td>13</td>
<td>11.866</td>
</tr>
<tr>
<td>10</td>
<td>Gendekore</td>
<td>0.56</td>
<td>1,216,447</td>
<td>1,238,983</td>
<td>632,917</td>
<td>12</td>
<td>21.746</td>
</tr>
<tr>
<td>11</td>
<td>Berber</td>
<td>0.65</td>
<td>477,819</td>
<td>227,987</td>
<td>33,145</td>
<td>4</td>
<td>6.776</td>
</tr>
<tr>
<td>12</td>
<td>Dibate</td>
<td>0.59</td>
<td>966,062</td>
<td>306,596</td>
<td>369,891</td>
<td>8</td>
<td>18.203</td>
</tr>
<tr>
<td>13</td>
<td>Bambasi</td>
<td>0.35</td>
<td>1,208,103</td>
<td>2,459,567</td>
<td>350,252</td>
<td>18</td>
<td>22.84</td>
</tr>
<tr>
<td>14</td>
<td>Kirkos</td>
<td>0.70</td>
<td>1,216,409</td>
<td>1,564,195</td>
<td>332,759</td>
<td>21</td>
<td>17.811</td>
</tr>
<tr>
<td>15</td>
<td>Hiwot Amba</td>
<td>0.73</td>
<td>1,207,882</td>
<td>311,797</td>
<td>112,498</td>
<td>23</td>
<td>21.314</td>
</tr>
<tr>
<td>16</td>
<td>Meshualekia</td>
<td>0.87</td>
<td>566,760</td>
<td>794,547</td>
<td>463,211</td>
<td>7</td>
<td>17.827</td>
</tr>
<tr>
<td>17</td>
<td>Kebeha</td>
<td>0.67</td>
<td>1,517,070</td>
<td>1,490,424</td>
<td>181,905</td>
<td>29</td>
<td>40.243</td>
</tr>
<tr>
<td>18</td>
<td>Semien</td>
<td>0.77</td>
<td>1,800,771</td>
<td>1,009,141</td>
<td>216,504</td>
<td>26</td>
<td>32.776</td>
</tr>
<tr>
<td>19</td>
<td>Arada</td>
<td>0.56</td>
<td>1,444,507</td>
<td>2,362,041</td>
<td>254,008</td>
<td>32</td>
<td>56.644</td>
</tr>
<tr>
<td>Total Urban</td>
<td></td>
<td>21,300,119</td>
<td>20,128,764</td>
<td>8,827,313</td>
<td>304</td>
<td>397</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>#</th>
<th>Inefficient Health Centers</th>
<th>Technical Efficiency Score (%)</th>
<th>HR Costs</th>
<th>Drugs and Supplies Costs</th>
<th>Indirect Costs</th>
<th>Medical Staff</th>
<th>Non-Medical Staff</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Debark</td>
<td>0.80</td>
<td>438,271</td>
<td>337,536</td>
<td>122,796</td>
<td>3</td>
<td>13</td>
</tr>
<tr>
<td>2</td>
<td>Jiga</td>
<td>0.93</td>
<td>194,860</td>
<td>71,783</td>
<td>9,455</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>3</td>
<td>Mankusa</td>
<td>0.91</td>
<td>87,370</td>
<td>405,420</td>
<td>9,700</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>4</td>
<td>Birity</td>
<td>0.84</td>
<td>73,462</td>
<td>56,743</td>
<td>21,990</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>Angada</td>
<td>0.90</td>
<td>123,773</td>
<td>98,143</td>
<td>8,070</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>Biyoaawale</td>
<td>0.63</td>
<td>1,034,114</td>
<td>345,664</td>
<td>1,529,246</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td>7</td>
<td>Galisa</td>
<td>0.74</td>
<td>307,846</td>
<td>222,962</td>
<td>15,654</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Total Rural</td>
<td></td>
<td>2,259,695</td>
<td>1,538,250</td>
<td>1,716,912</td>
<td>24</td>
<td>49</td>
<td></td>
</tr>
<tr>
<td>Total cost saving (rural and urban)</td>
<td></td>
<td>23,559,815</td>
<td>21,667,014</td>
<td>10,544,225</td>
<td>328</td>
<td>446</td>
<td></td>
</tr>
</tbody>
</table>
One study found that clients’ perceptions of health care providers skill and competency and satisfaction were important predictors of utilizing community clinic services in Bangladesh (34). Another study found by using geographic information systems that there was a significant decline in usage of health care services with an increase in travel time to primary care providers in rural South Africa (37). Quality service provision might be more important compared to improved access in order to increase primary care utilization, as demonstrated in one study conducted in rural Nepal (31).

Other factors related to planning such as fiscal transfers from national to sub-national levels based on a defined formula, negotiation powers of a local government, and allocating human resources based on standards or norms instead of workload or output may cause supply-side inefficiencies. Close to 60% of the woreda’s overall budget allocation comes from fiscal transfers of block grants from the federal and regional levels (8). This rather limited budget is constrained by competing sector priorities to health such as education and agriculture. Furthermore, anecdotal evidence points to potentially some woredas with stronger negotiation abilities, compared to others, which leads to greater budget allocations. The use of staffing standards or norms may lead to an imbalance between staff and patients served, thus an inefficient allocation of human and financial resources compared to patient load. Health facilities with low patient-loads may experience an underutilization of allocated human resources, while facilities with high patient-loads may not have enough human resources to meet patient needs.

Limitations of study

The main limitations of this study are due to the data collected to conduct the PHC cost study, which this analysis pulls from, and approaches used for the efficiency analysis.

This analysis is not a statistically representative sample of health centers in Ethiopia. The sample is small, accounting for only 1.2% (or 40 out of 3,292) of total health centers is included in this study (38). However, the sample of health centers represents geographic differences by capturing facilities from major urban, agrarian, and pastoral settings.

This analysis excludes both primary hospitals and health posts. Very few primary hospitals were functioning during the time of the PHC cost study (EFY 2006), and therefore only 6 primary hospitals were included in the study. An additional data collection activity and analysis is now completed for 18 more primary hospitals and a similar analysis will be done with that sample. For health posts data quality was insufficient for a robust cost analysis (16).

Efficiency scores produced by the DEA models are sensitive to the health facility sample and model specification. These scores are based on the relative efficiency from the other health centers in the sample and not based on the optimal mix of inputs and outputs for all health centers in Ethiopia. If a different DEA model was specified, or one used different inputs and outputs, then one may get different results in the efficiency scores and cost savings.

Other factors might be influencing the efficiency findings. For example, one health center might appear to be “efficient” with low unit cost per output. However that facility might have lower costs because it is lacking key resources such as experiencing regular stock-outs7. Health centers with relatively low efficiency might be due to low utilization rates based on remote placement of health facility, limited access to road infrastructure; factors beyond the control of the health sector. The efficiency analysis presented in this paper only compares the relative efficiency to other health centers within this small study. We might not be capturing true or optimal efficiency between the supply and demand of health care provision among all health centers.

---

7 This was not accounted for, and one of the limitations, in the PHC cost study (16).
4. Conclusions and Way Forward

This analysis for health centers demonstrates some potential areas where improvements in resource allocation and use could lead to more efficient health service provision within the mid-level primary care facility. Cost efficiency was assessed for total health center efficiency, department-level efficiency, and input efficiency. Some health centers and departments appeared to be significantly more efficient compared to others in terms of resource use relative to output, input productivity, and pure technical and scale efficiency.

Health center expenditures increased as the number of outpatient equivalent visits increased, but horizontal and vertical spreads indicate possible inefficiencies within the sampled health centers. Some health centers had high spending but low output, which may indicate inefficiency in resource use such as over staffing relative to utilization rates. Other health centers appear to be more efficient with low levels of spending relative to output.

Certain factors are not captured in the data used for this analysis that might also influence expenditures levels, like quality of service provision (e.g., clinical staff spending more time with patients or keeping a readily available stock of unexpired drugs and pharmaceutical supplies), which may inherently have higher costs.

It is evident that economies of scale occur as more people are accessing care from health centers, although this appears to hold true only across certain departments (OPD, delivery, and MCH for urban health centers only). One study found that a 1% increase in patient load statistically significantly decreased cost per visit by 27% (39). Mechanisms to improve efficiency should also focus on demand generation activities for this level of care, and not solely on supply-side factors.

Among the sampled health centers, we found differences in the distribution in spending across regions and between urban and rural areas. There was higher per capita spending among health centers located in urban areas compared to those in more rural areas. Such differences are not necessarily due to inequitable resource allocation of public funds but might be caused by differences in the distribution of clinical staff relative to utilization rates, and thus an imbalance of per capita health spending between urban and rural sites. Service volumes may increase for both rural and urban health centers with the introduction of social health insurance and scale-up of community based health insurance schemes.

Some departments within health centers appear to be more efficient in resource use compared to others. All departments, with exception with IPD, show a linear relationship between department level expenditures and outpatient equivalent visits. IPD in rural health centers either have high spending and low output or high output and low spending. The former relationship indicates possible inefficiencies in resource use relative to output levels such as too many staff or health centers forced to procure drugs and pharmaceutical supplies from private dispensaries, which are more costly, due to stock-outs. Flat or same level of spending is apparent for both OPD and delivery departments among rural health centers despite increases in outpatient equivalent visits.

The increase of functioning primary hospitals may make it less desirable for health centers to offer certain types of services. OPD, MCH, and IPD services offered at a health center are lower in cost per patient compared to primary hospitals. It might be more cost-efficient for health centers to focus on certain OPD and MCH related services given the lower unit cost. Additional evidence on the most cost-efficient health providers for certain primary care services in needed.

Most health centers have a large number of clinical staff relative to outputs. Health worker productivity is very low with an average 3.7 outpatient equivalent visits per clinical staff per day. The health centers in this study have a large number of clinical staff relative to outpatient equivalent visits; Amhara had the highest with an average 5.5 visits per clinical staff and Benishangul-Gumuz had the lowest at 2.5. This low output production is brought on by low demand and high supply of clinical staff to health centers in Benishangul-Gumuz, where all facilities are above the minimum standard of clinical staff. Low average output production is consistent with findings among other developing countries such as Kenya and Zambia.
Fifty-four percent of the health centers sampled were purely technically inefficient, suggesting wastage or inefficiencies are occurring because more resources than necessary are being used given the level of output. A potential cost-savings of 55.77 million birr for the study year was estimated if certain inputs were reduced such as clinical staff, drugs and supplies wasted, and indirect expenditures. This accounts for a potential cost-savings of 5.5 million birr and 50.26 million birr for rural and urban health centers, respectively. These are factors that a health provider can control however the reduction of some of these inputs such as clinical staff would not necessarily be a good policy. Another way to improve such costly inefficiencies would be to increase output. Almost all of the health centers were scale inefficient with an average scale efficiency score of 82%, suggesting that on average these inefficient health centers could increase their output levels by 18% given their size and capacity. It would be beneficial for the FMOH to continue the adoption of demand generation activities such as behavior change communication to increase outputs for health centers.

One must be very cautious in drawing strong conclusions from this analysis because this current analysis does not show why potential inefficiencies (or efficiencies) are occurring among the sampled health centers, and whether these are influencing factors nationwide. Solutions to the inefficiencies highlighted in this report for health centers are still not clear, more work needs to be done.

Additional questions arise as a result of the findings presented in this report. Such questions include: What internal and external factors have influenced the efficiency findings? Does an efficient health center provide quality and equitable health care or does efficiency occur with inadequate provision of health services due to factors such as stock-outs – reducing costs to the facility potentially along with a patient served? What is the most appropriate funding and input mix for health center service delivery in order to be most cost-efficient? Why do health centers in urban areas appear to be considerably less efficient than health centers in rural areas; is it because there is greater access to private health care facilities in urban areas and less demand for public care or are these health facilities so different from rural health centers that they should be analyzed separately?

Producing further evidence that attempts to answer these and other questions on efficiency of primary care providers would provide the FMOH with the complete picture of cost efficiency and ways to improve it for a more efficient and equitable primary care system. Proposed activities for the Health Economics and Financial Analysis case team in the next EFY attempt to answer such questions in order to support the HSTP and National Health Finance Strategy implementation. Suggested activities for future efficiency analytical work consist of:

- Incorporating primary hospitals into analysis – once data collection, cleaning, and analysis are complete.
- Conducting site visits to health facilities that were found to be least and most efficient to understand factors influencing findings.
- Improve data collection done by health facilities (this will also facilitate in the improvement of the planning and budgeting process). Identify areas to strengthen the information system and improve data quality.
- Use the Service Provision Assessment Plus (SPA+) survey data to conduct a more representative, comprehensive efficiency analysis.
- Conduct analysis to estimate allocative efficiency for health centers and primary hospitals.
References


I. Introduction

II. Methods

III. Results

IV. Discussion

References


