TECHNICAL EFFICIENCY OF PUBLIC PRIMARY HEALTH CARE FACILITIES IN MOMBASA COUNTY.

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DECLARATION

This research report is my original work and has not been presented for award of a degree in any other University.

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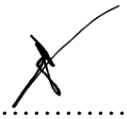
Signature  ……

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The research report has been submitted for examination with my approval as a university supervisor

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LIST OF ABBREVIATIONS

AE- Allocative efficiency

CHS- Community Health Strategy

CRS- Constant Return to Scale

DEA- Data envelopment analysis

DMU- Decision Making Unit

DRS- Decreasing Return to Scale

EU-European Union

IRS- Increasing Return to Scale

KEPH- Kenya Essential Package for Health

MOH- Ministry of Health

NHA- National Health Accounts

NHIF-National Hospital Insurance Fund

ODA- Official Development Assistance

PHC-Primary Health Care

SFA- Stochastic Frontier Analysis

TE- Technical Efficiency

UHC-Universal Health Coverage

UNICEF-United Nations International Children's Emergency Fund

USAID-United States Agency for International Development

VRS- Variable Return to Scale

WHA- World Health Assembly

WHO- World Health Organization

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ABSTRACT

Primary health care facilities offer essential health and wellness services to a significant percentage of the population in Kenya. Evidence based planning and management of available resources in these facilities remains critical for optimization of health care outcomes. This research hence aimed at measuring technical efficiency of Health centers and Dispensary in Mombasa County using Data Envelopment Analysis (DEA). Data was obtained from the County health records and District Health Information System (DHIS2) for the year 2019. 18 primary health facilities were evaluated. Output variables were; outpatient visits, deliveries, antenatal visits and postnatal visits while inputs considered were; number of staff and funds received. The result reveals that dispensaries had an average constant return to scale (CRS) efficiency of 88% with the least efficient dispensary scoring 48%. The average variable return to scale of the dispensaries was 96%, while the least efficient scored 72%. Scale efficiency of the facilities ranged from 56% to 100% with an average score of 91%. Health centers on the other had had an average CRS of 97% and VRS score of 99%. Their scale efficiency ranged from 92% to 100%, with an average score of 98%. The study recommends reallocation of resources and expansion of service output through creation of service demand for the inefficient facilities.

CHAPTER 1: INTRODUCTION

1.0 Introduction

Primary health care facilities offer essential health and wellness services to a significant percentage of the population in Kenya. Evidence based planning and management of available resources in these facilities remains critical for optimization of health care outcomes. It has been regarded to be key in achieving universal health coverage as it enhances effective health service delivery (Novignon 2017). However, despite its significance, majority of PHC facilities are faced with a number of challenges that hamper their effectiveness. (WHO, 2008). There is need deploy more resources to these facilities through various means. Improving efficiency in these facilities can result in saving resources which can be reinvented into the health system (Haller PS, 2005). In this regard, this study intending to empirically provide evidence efficiency in the sector. This chapter will be elaborated under the following sub-headings: The background and the statement of the problem in regard to the study area, research questions, objectives to be met as well as justification of the study.

1.1 Background

Strong and Effective primary health care has been associated with achievements of the World Health Organization (henceforth WHO) Alma Atta declaration of 1978. According to WHO, Primary health care is a basic right and an essential health care that encompasses applied systematically sound and socially acceptable procedures and technology that are universally accessible to everyone in the community. Being the elementary and entry point to formal healthcare, PHC assures universality and progression of care all through the patient's life (Emmanuel et al, 2011)

Primary health care has eight elements as stipulated in the Alma Atta declaration which include; Immunization against major infectious diseases, Health education on prevailing diseases, local endemic disease control, clean water supply and elemental hygiene, Mother and child healthcare including family planning, Essential drugs provision, Nutritional and food supplementation, Basic curative services (communicable and non-communicable ailments) and promotion of mental health. Kenya which is a signatory of the declaration, added five more elements which are; Oral health (OH), Mental health (MH), human immunodeficiency virus (HIV)/ acquired immunodeficiency syndrome (AID), Primary eye care (PEC), and Health Management information systems (MOH 2019). PHC is anchored on 4 pillars which comprise of; community participation, intersectoral collaboration, appropriate technology, support systems made available through decentralization and fair distribution.

Luisi & Hamel, (2021) argue that people's participation has been found as a tool to empower communities and an important approach in realization of equity in health as well as community driven primary health care. According to the World Health Organization (2002), community participation is whereby communities are facilitated towards becoming part and parcel and actively getting involved in identifying concerns that are of importance to their lives and wellbeing. Communities decide on elements that influence their lives as well as participate in formulation and implementation of required programs. It also encompasses taking an active role in the planning and development of care interventions and delivery of services. Communities that embrace participation with their respective health service providers and policy makers have a chance to contribute in assessing their own needs, set priorities and be part and parcel on implementing critical programs hence there is perceived ownership of sector activities. Through

community participation, resources can be targeted in a more effective way hence leading to efficiency in utilization of resources (WHO 2002).

Collaboration emanating from the health sector and other sectors such as water and sanitation, energy sector, transport, information and technology are crucial for realizing of healthcare goals (WHO 2017). Water and sanitation services enhance good infection control practices while energy drives most of the processes including diagnostic and general lighting of institutions. Movement of health care commodities is achieved through reliable transport network and infrastructure while information and technology sector bring in adoption of appropriate technology and also tools that aid in decision making such as data collection, processing and analysis tools, computer aided diagnostic tools, and telemedicine platforms. Governments carry the greatest burden when it comes to performance of a nation's healthcare system, however it is in its jurisdiction to involve all sectors within the society in its management (WHO 2000).

The World Health Organization report (2016) notes that there are other factors that have an impact on the health sector such as education, income, security but are not primarily under the health sector's mandate. This can be addressed through a formidable framework on intersectoral collaboration. Martin-Moreno et al., (2021) asserts that education on health and lifestyle is key in preparing individual to make important life decisions, however such decisions are equally influenced by environmental factors, income, urbanization, agriculture and infrastructural developments within reach. The mentioned factors to a great extent influence individual behavior and character.

Primary healthcare has a central part in reduction of household spending on health by focusing on fundamental factors influencing health. It requires an attention to community or household level services that assist in prevent illness and hence by extension, promote well-being of the

community or household. Through this, it is expected that individualized household care will be reduced hence increased monetary protection for their health services (WHO 2018). Underlying determinants of health that may be tackled through basic healthcare evidence-based policies include; socioeconomic and environmental aspects, as well as behavioral individual attributes.

The Sustainable Development Goals (SDGs) in the 2030 SDG Agenda present an ambitious platform through which health and wellbeing can be addressed particularly through Sustainable development goal 3. SDG3 advocates for attempts that secure healthy lives and promote wellbeing for all. PHC plays a vital role in achieving the SDG3 targets. Some of the targets are; reducing maternal mortality, reducing newborn and infant mortality, ensuring universal access to sexual and reproductive health care, strengthening the prevention and management of substance abuse, preventing and treating non-communicable ailments which count on multisectoral strategies and interventions that advance good health and well-being, integrated health care that gives priority to basic public health care approaches and also empowering people and communities (UNICEF 2018). Target 3.8 on the SDG health goal emphasizes on delivery of basic quality services in consideration of financial barriers for all. (WHO 2016). The World Health Organization equally notes that it is paramount for nations to build capacity on their health systems for them to accommodate the changing health needs and priorities that are attributed to changes in population patterns, transformations in epidemiology, rapid changes in technology and shift in public expectations.

PHC institutions demand significant fraction of the health docket's resources, therefore these facilities are key as far as healthcare resources are concerned. Health sector reforms initiatives ongoing in many underdeveloped nations places immense focus and emphasis on primary health systems as the entry level to formal health institutions (Akazili et al, 2008). Facilities that offer

these services may vary between countries and regions, however majorly services are offered at health centers and dispensaries in public health systems while in the private health sector, clinics and nursing homes offer the services

Research carried out by Oikonomou et al, in 2014 on efficiency of Greek primary care noted that Health centers and Regional Surgeries (RS) offer primary health services in semi-rural and rural parts of Greece. With a population coverage of between 2,500 to 50,000, the centers provide basic diagnostic, preventive and curative services. The workforce establishment comprises of internists, nurses, lab assistants, general practitioners, technical and administrative personnel and other specialists. Regional Surgeries are smaller health units attached to the health centers serving smaller villages.

In Japan, the health-care structure does not clearly differentiate primary care from high level care hence there is no gate-keeper system in place. Patients often visit high level health-care institutions regardless of the ailment, and the services are accessed directly at a reasonable cost without having to be referred from lower-level health care facilities. Provision of secondary services can be done locally at primary level facilities or care centers, alternately the services can be accessed at outpatient section of higher-level facilities that would be considered tertiary hospitals in a gate-keeping structure. There have been attempts by the Japanese government to institute a referral system for those intending to utilize hospital services through clinic services, whereby clients having no referral letters from primary care clinics are required to pay a minimum of 50 dollars to access services at larger-size hospitals. Through this fee reduction, there has been a significance reduction outpatient attendance of level five and above hospitals leading to patients prioritizing community-based clinic However, the division between

elementary health care and upper-level health-care systems in Japan remains ill defined (Sakamoto, 2018)

Enrique et al. (2018) noted that basic health care in Spain is a central constituent of the overall health sector, professionals within PHC form the basis of the Spanish National Health System (SNS). Public healthcare providers which include family physicians and nursing officers are essentially the ones providing preventive health care to all (the women, the children, acute, women, chronic care as well as elderly patients). Gonzalez-de-Julian et al., (2021) asserts that assessment of PHC efficiency is crucial, for the purpose of detecting the different challenges that hamper the ability to deliver optimal quality health care services to community at affordable healthcare budget.

PHC services are well provided by organized and effective multi cadre teams with a wide skills base and proficiency to tackle the diverse health care needs of the catchment communities, close to where they reside. Basic health care professionals are preferably multidisciplinary and may include; doctors, nurses, community health volunteers, clinical officers, physiotherapists, nutritionists, health administrators & managers, social workers, pharmacists, community oral health officers, traditional healers and support staff (WHO, UNICEF 2018).

In China, Shi Zheng et al., (2019) studied the expertise, capabilities, and skills of primary health care providers in Seanern countries and noted that the professionals have a critical role in offering both primitive services and preventive service worthy noting also was that provision of PHC relied on doctors, nursing officers, midwives, subordinate staff, support staff, appropriate trained to work interdependently and to community health care needs.

Margherita et al., (2021) notes that primary care in England begins at the entrance into the health care structure. According to him, future investment in health care workforce can manage the growing demand and complexity of care if priority is given on improving primary care efficiency and productivity.

In Ethiopia, Teklehaimanot D. & Teklehaimanot A., (2013) observed that the health care structure has health posts and referral health centers offering basic healthcare. The health posts deliver desegregated services in structures that are designed to handle multiple tasks, this is done in order to attain the most out of the little resources. The health centers however have more space to accommodate more services including inpatient, maternal and child health care and efforts were in place to expand their scope to incorporate emergency obstetric care including setting up a major surgery theater.

In Ghana, PHC services are offered by health centers, clinics, community referred as Community-Based Health Planning and Service (CHPS), and also traditional healers. The centers and health clinics serve a catchment of between 15,000– 30,000. Services offered mainly are preventive, child welfare and immunization, maternal health and also curative services. These facilities are linked with the higher levels of care (district, regional, teaching and referral hospitals) in a well-structured referral system where advanced and specialized services are offered (Robert et al, 2015).

Akazili et al, (2015), noted that health centers in Ghana being the gate keeper health institutions to formal care consume a large amount of the district resource allocation. This is because of the strategy to unburden the referral centers and enhancing effective care at the primary level. Additionally, there are endeavors to strengthen health centers to offer basic and effective

health care to the catchment population as well serve as referral recipients to the facilities in the lower level.

South Africa has a public elementary health care system that offers services via a nurse-based, doctor-supported system with above 3500 facilities with also community health facilities, located not further than 5 kilometers to over 90% of the population (WHO 2017). Andrew et al, (2017) noted that the system is supported by an emerging structure of community-based outreach teams comprising of community health volunteers. At the same time, there general practitioners and traditional healers providing primary care services at a fee.

Health systems reforms being undertaken in most underdeveloped countries note that apart from reduction in health sector funding, other concerns like deteriorating quality of care brought about by a number of inefficiencies in all levels of healthcare are major issues faced by the sector. This has necessitated several reform programs and strategies in many developing countries (Akazili et al, 2008). Health system reforms address issues of equity, efficiency, quality, financing, and sustainability in the provision of services, and also in identifying the priorities, aligning the strategies and restructuring the facilities where policies are executed, targeted issues in the restructuring were, healthcare financing, reforms on provision of healthcare, resource generation and governance in healthcare (WHO 2000)

Equity in health care is the absence of unfair and avoidable disparities in health amongst population groups within the same social, economic, demographic and geographic confines (WHO 2000). Incorporating the concepts of equity and efficiency complementarily while pursuing maximum and equal health for the community is paramount. The core principles of global health care lie on fairness in access to all and financial protection which is however been limited by spiking in health care costs, catastrophic expenditures to the poor members of the

society in utilizing available health care resource. This has an implication in efficiency gains so far made in equity UHC realization.

Professional skills and knowledge that is based on evidence is paramount when it comes to quality. It is based on evidence-based professional knowledge. Efficiency is one of the domains in healthcare quality with other domains being; safety, effectiveness, patient centeredness, timely and equitable. Some of the strategies to improve quality include; adoption of best practices, establishment of quality improvement programs coupled with health service planning, continuous professional development (training), tools to support clinical decisions (clinical guidelines) and health workforce incentives.

The World Health Report of 2000 (WHO 2000) postulates that the varying levels of inefficiency within different health systems and their financing approaches has led to notable disparities in health outcomes even in nations whose level of income is at par. Governments have the ultimate role to manage health resources for their respective populations. The reports also notes that accountability and efficiency in deployment and overall management of resources has led to positive health outcomes.

The WHO &UNICEF (2018) joint series on primary health care notes that even though extra financial resources have been and continue to be devoted to health, PHC still requires more allocation of funds. Resources need to be mobilized and allocated judiciously so that adequate funding is in place to ultimately support PHC activities. It should be emphasized that the aforementioned model is less costly and generates efficiencies, delivers good health outcomes and deploys lesser resources than other approaches. There is need for emphasis on utilization of resources efficiently, particularly given fiscal space limitations.

Analyzing efficiency of health care systems is more critical because of the huge financial contribution of central governments to health systems. Equally, the assessment of health system efficiency has a significant input to health policy decision making (Karagiannis 2016). Efficiency in health services provision is achieved when available inputs are used in the best possible way by producers. The reduction in inefficiency in health care systems has also a positive impact on health service consumption.

1.1.1 Healthcare provision in Kenya

Since Kenya attained independence in 1963, health for all has been observed as a fundamental right (Oyaya & Rifkin, 2002). The government took the role of health care provision during the post-independence error with an objective of strengthening and undertaking interventions to prevent, eradicate and control of diseases, offer sufficient and efficacious diagnostic, curative plus rehabilitative care to the citizens (Government of Kenya, MOH 1986). Various health sector reforms have been undertaken to achieve these objectives. Key highlights in this reform journey are the adoption and domestication of (i) World Health Assembly resolutions (1977); (ii) Health for All (2000); (iii) The 1978 Alma-Ata Declaration on Primary Health Care and (iv) ‘‘Global Strategy for Health for All (1981)

Policy guidelines have over time been developed to offer direction on key investment areas and targets on health indicators. The “Guidelines for the implementation of primary health care” were published in 1986. Operationalization of the guidelines led to restructuring of the health care structures centered on the principles of decentralization, community participation, and intersectoral coordination (Oyaya & Rifkin, 2002). A significant health policy shift was experienced in the early 1990s with focus on reforming institutions and structures and reorienting of health services to conform with market demands after the World Development

Report; ‘‘Investing in Health’’ was published in 1993. This report emphasized on systemic reforms and reallocations of public spending that ensures elementary public health activities and essential clinical care as the rest of the health system becomes self-reliant. Another key message from the report was on improvement of government spending on health through; 1) Reduction of state expenditures on higher level facilities, specialist training, and packages that provide minimal health gain for the money spent, 2) Financing and implementation of public health interventions to deal with the considerable externalities around infectious disease mitigation, 3) Financing and ensuring provision of a bundle of essential clinical services.

The Kenya Health policy framework 1994-2010 is another key policy paper which focused on devolving health service management to lower levels (district) thus creating the district health management teams (DHMTs), which were strengthened and supported to coordinate care within the districts. The enactment of KHPF 1994−2010 brought about significant resource inputs in public health programs and lesser allocation in medical services, leading to improvement of health outcomes in areas such as communicable diseases control and child health. Nevertheless, the emerging rise in non-communicable diseases threatened the gains made so the policy. This KHPF policy was succeeded by The Kenya Health Policy 2014-2030 which had an objective consolidating the gains accomplished, at the same time guiding achievement of further gains in an equitable, responsive, and efficient manner (Government of Kenya MOH 2014)

The Kenya Health Policy 2014-2030 emphasizes on the need to manage resources efficiently given the constraints vis a vis the disease burden (Anthony, 2017). It’s noted that reasonable policies and frameworks are in place, however drawbacks exist in implementation thus resulting in wastage. The following principles are were noted to be fundamental in this policy; 1) The adoption of the new 2010 constitution in Kenya introduced a devolved system of governance.

The new dispensation provided for two levels of governance (County and National) which are distinct and interdependent. Health care provision was extensively devolved under this constitution with County Governments taking up most of the functions, (Kenya MOH 2014). The national government is tasked with formulation of policy and regulatory frameworks, management of national referral hospitals, The Kenya Medical supply Agency (KEMSA), The National Hospital Insurance Fund (NHIF), National quality control laboratory (NQCL) and National blood transfusion services among other roles. While counties are in charge of health facilities and pharmacies within the counties, ambulance and referral services, primary health care promotion, issuing license and regulating entities that vend food to the public. Other interventions include environmental health services, communicable diseases management, and nutritional services.

The healthcare system in Kenya is organized into levels beginning with the community under the community health strategy, and then through a defined linkage network builds up to tertiary levels of healthcare (Kenya MOH 2014). Primary care facilities comprise of dispensaries and health centers. The present-day structure has six levels: Level 1 being Community health provision under the community health volunteers, Level 2 are Dispensaries, Health centers are at level 3, Subcounty hospitals which are Primary referral facilities are at level 4, Level 5 are County Hospitals and Level 6 are National teaching and referral hospitals)

The community health strategy (CHS), a concept based on Primary health care was rolled out in Kenya in 2006 and later updated in the year 2013 to align with decentralization of health care services. CHS is considered as a key pillar to primary health. Evidence revealed that the realization of Millennium development Goals (MDGs) requires nations to foster partnerships to

enable enactment and facilitate active community participation in programs aimed at achieving MDG targets (Kenya MOH 2020)

CHS has a current strategic plan (CHSP 2020-2025) which is the latest road map that aims at improving provision of service to the Kenyan population by way of consolidated, participative and sustainable community health interventions, in pursuit of Universal Health Coverage. The strategy outlines a number of objectives and inputs to the community health structures. It aspires to escalate and invest sustainably into community health based on innovative localized resource mobilization programs. Additionally, it is also aiming at integrating community health into the mainstream health care structures through promotion of strategic partnerships and accountability amongst partners cutting across levels of the health system. These objectives are in tandem with the global perspective of health systems integration and evidence in favor of a universal approach to healthcare provision in line with UHC (Kenya MOH 2020). Seven strategic[1] directions are outlined in this plan.

[1] 1) Strengthening the management and coordination of community health governance structures at all levels of government and across partners, 2) Building a motivated, skilled, fairly distributed community health workforce, 3). Increasing viable financing for community health 4). Strengthening the provision of comprehensive community health services that are integrated and of high quality, 5). Increasing the availability, quality, demand and consumption of health information, 6). Ensuring that commodities are available and are of high quality and also are rationally distributed, 7). Creating an arena for strategic engagement with partners besides accountability among stakeholders and quarters at all levels.

Health care financing is central to the functioning of a healthcare system, it determines access and package of care and the level of financial protection (Augustine A. et al 2020). In Kenya, the National Health Accounts (NHA) 2015/2016 reported that Revenues to finance financing schemes come from three major sources namely the government, households and donors. The Total Health expenditure (THE) was Kenya Shillings 346 billion in FY 2015/16, compared to Kenya shillings 271 billion in FY 2012/13. Donor funding mostly supports vertical programs like HIV/AIDS care and treatment, Tuberculosis treatment, and Malaria control.

Official development assistance, has a critical role in Kenya's financing landscape. Health being one of the largest beneficiary sectors of development aid in the country; over the last 10 years, aid to the health sector has made up roughly one third of total the total official development assistance. In the year 2002, the proportion of health official development assistance out of total assistance was 21%; this level increased steadily and by 2010 it was at 38%, recent levels still remain high at 31% (McDade et al. 2021). The reclassification of Kenya from lower income country (LIC) to a lower middle-income country (LMIC) in 2014 brings a shift in its financing portfolio, with gradual transition into self-reliance. McDade et al (2021) argues that with such financial shifts, there is a possibility of losing development gains achieved while receiving significant external financial support if not carefully managed.

Table 1: Kenya's Fiscal space trends

Indicator	**2005**	**2009**	**2014**	**2019**
General government health expenditure (GGHE) per capita (in Kenya shillings)	928.8	1,674	2,948	3,531.6

General Government health expenditure (GGHE) as a % of Current Health Expenditure (CHE)	27.9	27.9	37.4	42.7
Out of Pocket expenditure as a percentage of CHE	44.9	31.5	29.2	24.0
External funding for health as a percentage of CHE	17.3	29.5	20	17.0

Source: (The World Bank, 2020),

There has been a progressive increase in the total amount of health expenditure pooled through prepaid mechanisms. Dutta, et al., (2018) however noted that funding from households and external sources still constitute a significant fraction of health care expenditure in Kenya. Furthermore, out of pocket charges that are levied at point of care dominate household expenditures which create financial hardships that threaten the household's financial security. Efforts have been going on to escalate pooling financial resources through the National Hospital Insurance Fund (NHIF) and introduction of programs of like Linda Mama and free primary healthcare with the aim of reducing point of care healthcare expenditure. However, funds pooled from household through NHIF is still too low making out of pocket expenditure remain significantly high.

The Kenya Household Health Expenditure Survey (KHHEUS) of 2018 reported that approximately 20% of the population in Kenya report to have some form of insurance according. Among the 20%, 89% were insured under the National Hospital Insurance Fund (Kenya MOH 2018)

Table 2: Key macroeconomic and health financing indicators trends in Kenya

	Year		
Indicator	2010	2015	2018
Gross domestic income in Kenya shillings	3.068 trillion	4.021 trillion	4.809 trillion
Current Health expenditure per capita in US dollars	58.212	69.77	88.385
Out of pocket expenditure per capita in US dollars	17.567	18.769	20.877
Life expectancy at birth for male and female (years)	60.959	64.79	66.342
Under five mortality rate/1000 live births	53.4	45.4	40.6
Infant Mortality rate per 1000 live births	39.4	35.3	31.9
Maternal mortality ratio per 100,000 live births	432	353	342

Souurce: The World Bank, 2021.

The enactment of the 2010 constitution brought about significant changes on how health care finances are disbursed. The establishment of the County Fund (CRF) in the constitution gave much authority for health spending to the counties. The national treasury sends from the national level through the counties, Dutta et al., (2018) observes that there are some conditional funds

earmarked for interventions like free primary which is reimbursed to primary healthcare facilities for user fee foregone and Linda mama scheme that is administered through the NHIF.

The Free primary health care fund came about after the government adopted an alternative payment strategy in all public health care centers in 2013. Previous attempts had been made with focus was on reduction of most user fees in public health facilities except for registration charges. This led to the introduction of the Ksh. 10 or Ksh 20 registration fee policy to lessen the financial constraint of accessing health care.

After the abolishment of user fees for primary healthcare facilities, the government allocated Ksh. 700million in the financial year2013/2014 budget to compensate for loss of revenue and 3.8billion for free maternal services in the first year of the policy (USAID, 2018)

County budgetary allocations were insufficient in the first years after devolution owing the counties new responsibilities while health functions constituted 36% of the devolved functions, however there has been an increase in the allocation over time. County health allocation in the financial year 2013/2014 amounted to 42billion which doubled to 92billion in the financial year 2015/2016. Averagely, three quarters of the county allocations goes to recurrent expenditure mostly driven by expansion of wages and salaries. This leads to suppression of other healthcare resources that are key in achieving technical and operation efficiency in service delivery (USAID 2018)

Tsofa et al, (2017) noted that the new system of governance rooted on devolution of resources brought in an opportunity for grassroot based needs assessment, prioritization and community participation in planning for health as well as budgeting thus improving accessibility for local. There were also indications pointing to reverting the health facilities role in managing finances to a centralized level at the county.

There is need for programs that will continuously improve the knowledge and capability for planning, costing and overall management of finances in the health departments at the county stratum as well as operationalize community involvement and accountability frameworks (Tsofa et al 2017). By improving the county level capacity, opportunities brought by decentralization for improvement on overall healthcare management will be exploited.

Table 3: Free Primary healthcare and maternity services allocations

	FY 2013/2014	FY 2014/2015	FY 2015/2016	FY 2016/2017	Total
Free primary health care (millions)	Ksh. 700	Ksh. 900	Ksh. 900	Ksh. 900	Ksh. 3,400
Free maternity services (Millions)	Ksh. 3,800	Ksh. 4,000	Ksh. 4,300	Ksh. 3,800	Ksh. 15,950

Source: (Dutta, A., T. Maina, M. Ginivan, and S. Koseki, 2018)

The delivery of healthcare goods and services relies on various inputs and components that are used effectively and efficiently, an increase in demand for resources as evidenced in the healthcare expenditure trends above calls for the need to evaluate the health system performance and efficiency at all levels. Efficiency studies will indicate how well institutions utilize available resources

The Kenya Primary Health Care Strategic framework 2019-2024, which was developed purposefully to drive UHC noted that approximately 52% of Kenyans are able to access health facilities within a 5km radius, an observation that was attributed to insufficient equitable resource distribution and allocation. The framework also points out that adequate attention has

not been given to community mobilization which is an avenue for promoting awareness on the available health services at all levels.

The Astana Declaration of 2018 asserts that strong PHC system approach is needed to achieve universal health care. Strengthening of primary health approach while giving it the much-deserved focus is crucial for three reasons[2].

Governance of PHC facilities in Kenya is mandated to Health Facility Management Commitees (HFMCs), comprising of the facilities in charges and leaders elected from the catchment community. Community health units are overseen by Community Health Committees (CHCs) comprising of representatives drawn from the respective communities, Community Health Extension Workers (CHEWs) and Community Health Volunteers (CHVs) representatives. Following the devolution of health services, governance in these structures has remained relatively ineffective, this is partially associated to the way major decisions are now undertaken at the respective county offices, and not than at the national level. Additionally, their roles in community-represented governance bodies were reduced following scrapping of cost sharing

[2] 1). primary health care approach allows the health system to accommodate and respond to global dynamics. 2). It emphasizes on prevention and promotion while addressing the determinants in a people-centered approach, hence proving to be an effective and efficient way to tackle the main causes of, and risk factors for, ill health, and for handling the emerging challenges that may threaten health in the future. 3). It's through a stronger emphasis on Primary Health Care that Universal Health Coverage and the health-related Sustainable Development Goals can sustainably be achieved (MOH 2018).

revenue which previously, the committees had a role in deciding how the fees were managed (WHO 2017)

Primary Health care in Mombasa is provided under the guideline of the 2005 Kenya essential Package of Health (KEPH). The package highlights interventions that are cost-efficient and of high impact at different age categories, with defined service package at each level. It also outlines staffing requirements for PHC facilities. It also represents the integration of all health programs into one package that focuses its activities towards improving health at the various stages of the human growth cycle. It is expected to reduce fragmentation and enhance healthcare continuum by putting emphasis on interrelatedness of the various stages in human growth. It remains the primary strategy through which PHC services are delivered in Kenya. (MOH 2005).

The Department of Health (DoHS) in the County developed its second Health Strategic and Investment Plan (CHSIP II) 2018-2022, which guides the county's strategic health planning and priorities interventions for a period of five years. It points out specific deliverables where it seeks to make positive impact on the provision of health services to the residents of Mombasa County. The programme interventions have been designed within the context of emerging challenges and opportunities brought by the devolved health system. Also, emphasis is on improvement of the county's response to the current disease burden while focusing on disadvantaged populations and at the same time identifying key areas of investment for maximum impact.

PHC facilities in Mombasa County are mainly staffed by clinical officers, nurses and laboratory technicians, with a small percentage of medical officers. By 2018, the county had a total of 36 primary health care facilities out of which 25 were dispensaries while 11 were health centers. The county has also an elaborate community health strategy manned by teams of community health workers linking the communities to dispensaries and health centers through community

health units (Mombasa County Government 2018). The Mombasa County Health Strategic Plan 2018-2022 noted that the county had a total of 42 community units spread across the 6 sub counties.

By September 2017, the county's health department had its total numbers of human resource for health at 1631, of which, 126 were medical officers, 111 were clinical officers, 728 were nurses. The remaining were from other technical departments and support services (USAID, 2017). The County's Human resources for health information published in September 2017 noted that the Doctor/Clinical officer to patient ratio was 1:5367, while nurse patient ratio was 1:1747. The total number of medical specialists in the various fields was 35 with general surgeons having the highest number at 7 while the least were oncologists, radiologists, musculofascial surgeon, orthopedic surgeons, psychiatrist having one practitioner each.

Table 4: Primary Health Care Facilities in Mombasa County

Sub County	**Health centers**	**Dispensaries**
Mvita	Mvita Health center	Railway's dispensary Kaderbhouy dispensary Tononoka Ap dispensary State House dispensary Majengo dispensary King'orani Dispensary Mwembe Tayari Dispensary
Likoni	Mrima Health Center	Shika adabu dispensary

	Mtongwe Health center Mbuta Model health center	Mtongwe NYS Kenya Navy dispensary
Kisauni	Shimo main health center Mlaleo Health center	Junda dispensary Bamburi dispensary Shimo annex dispensary Borstal dispensary Marimani dispensary Maunguja dispensary Mwakirunge dispenasry Kisauni dispensary Utange dispensary
Nyali	Ziwa la ng'ombe health center	Maweni CDF
Changamwe	Chaani Health center Magongo Health center	Bokole dispensary Bangladesh Bamako dispensary
Jomvu	Jomvu Model Health center Mikindani Health center	Jomvu Bamako dispensary Miritini CDF dispensary Miritini MCM dispensary

Source: (Author, 2021)

1.2 Statement of the problem.

Primary healthcare is regarded to be key in achieving universal health coverage as it enhances effective health service delivery (Novignon 2017). However, despite its significance, majority of PHC facilities are faced with a number of challenges that hamper their effectiveness. (WHO, 2008). There is need deploy more resources to these facilities through various means. Improving efficiency in these facilities can result in saving resources which can be reinvented into the health system (Haller PS, 2005)

The County Government of Mombasa has been increasingly deploying resources to primary healthcare facilities since its inception in 2013. This is done to enhance access, coverage and quality of care. The County Health Strategic plan (CHSP 2018-2022) notes that the county has increased functional primary health facilities from 25 to 39 between the year 2013 and 2018. As at September 2017. the County had an aggregate number of 1631 healthcare staff, which is an increase from 1212 in 2014 (USAID 2017). Improvements have been noted in some areas while stagnation and worsening of health indicators has been noted in other key deliverables. The Kenya Population-based HIV Impact Assessment (KenPHIA) of 2018, noted that the county had a HIV prevalence of 5.6% which is above the national average of 4.9%. The proportion of fully immunized children dropped from 82% in 2013 to an average of 78% in 2017, while the county's tuberculosis burden rose from 519/100000 to 700/100000 during the same period (Mombasa County Government, 2018).

Allocations to health department constitute on average 23% of the total county budget over the past years. For a period of 4years; FY 2013/14 to 2016/17, the recurrent expenditure accounted for 83% which mostly was on employee salaries which is short of the 50% to 60% recommended

in the 2014 Senate bill. The Mombasa County Health Strategic plan (CHSP 2018-2022) notes that despite the huge investment in the health department, budget needs are not met across all facilities, yet there are no existing studies on primary healthcare efficiency assessment which are the gate keeper institutions in the health system. This study will contribute in bridging the information gap on the efficiency levels of primary healthcare institutions within the county. Specifically, this study will evaluate how resources are distributed in public health centers and dispensaries and also measure the technical efficiency levels in the DMUs.

The County Integrated Development plan (CIDP) 2018-2022 identifies the fundamental strategic priorities which are aimed at addressing health needs of the population; 1). Increase number of citizens accessing healthcare facilities from 43% to 75%. 2). Increase immunization uptake from 82% to 95%. 3). Increase the number of HIV clients eligible for antiretroviral therapy from 65% to 80%. 4). Increase the HIV+ pregnant women on antiretroviral preventive care from 54% to 100%. 5). Increase the number of hospital deliveries from 61% to 86%. 6). Increase the number of women in reproductive age bracket screened for cervical cancer from 10% to 55%. 6). Increase family planning uptake from 49% to 74%. 7). Decrease hospital based maternal mortalities from 249 to 64, 8. Decrease hospital based under five mortalities from 6.5% to 1.5%

The above identified targets require significant increase in funding and allocation of resources across all the health system pillars. For their realization, adequate human resource that is responsive to the population needs is required to deliver services that are accessible safe and of high quality without discriminating on socioeconomic grounds. Pooling of funds and strategic purchasing is also key while enough supplies of medical products, vaccines and technology will come in handy. Timely and appropriate relaying of information will be needed to make

evidence-based decisions. Action research is also paramount as new knowledge is needed in tackling emerging health care challenges.

1.3 Research questions

1. How are resources distributed within the public Health Centers and Dispensaries in Mombasa County?
2. What is the scale efficiency levels of public health centers and dispensaries in Mombasa County?
3. What are the technical efficiency levels and variations within the health centers and dispensaries in Mombasa County?

1.4 Objectives of the Study

1.4.1 Broad Objective

The broad objective of the study is to measure the technical efficiency of public health centers and dispensaries in Mombasa County for the year 2019

1.4.2 Specific Objectives.

i. To determine the resource level and distribution in public primary health centers and dispensaries within Mombasa County

ii. To determine the scale efficiency of public health centers and dispensaries in Mombasa County.

iii. To compare the technical efficiency levels in the public health centers and dispensaries in Mombasa County.

1.5 Study justification.

We cannot over-emphasis the need for efficiency in deployment of already scarce resources within the public health sector (WHO 2000). In the Kenyan health system, dispensaries and health centers are among the first formal contact linking the patients and the health system. Thus, this study will contribute towards informing decision makers on efficiency levels of public primary health care institutions in the county. Efficiency scores will constitute a baseline against which the county government can scrutinize the efficiency trends overtime and the effects of future health sector reforms. The methodology used in this study can be applied by to carry out similar studies in other counties in the country and also in developing modalities for performance monitoring and improvement as well in determining the likely savings.

CHAPTER 2: LITERATURE REVIEW

2.0 Introduction.

Literature review is a presentation of scholarly secondary materials published or unpublished that relates to the study area. It is useful in underpinning the state of art of the subject under consideration.

2.1 Theoretical literature review

Efficiency measurement in health care is an important for gauging the individual performance audits of health care units (Aref, et al., 2019). It pertains how rational resources are distributed and shared among institutions that provide health while seeking to maximize their output and key health care indicator outcomes. Health facilities ought to establish modalities that monitor and evaluate performance and also identify the determinants that form part of the health production functions (Cantor & Poh, 2017 as cited by AREF et al 2019).

Tandon, et al., (2003), define efficiency of a production unit as the attained level of output in comparison to the maximum level that could be attained using given number of resources. Attainment of efficiency is influenced by productivity. A firm's productivity denotes the ratio of output(s) generated to the input(s) utilized (Coelli, et al., 2005). The measure involves all factors of production, hence also termed as total factor productivity.

Efficiency refers to a comparative performance of health care production units. To Krugman, (2004) what efficiency and productivity can be used interchangeably. For instance, productivity, which is simply output-input volume ratio can reveal on how efficiently health care production is. Based on its global acceptance, it has been used for both international and national comparisons of health care outcomes. A case study is on the impact of product and labor market regulations on economic performance. However, its application as a universal scale for gauging

the comparison of different countries lies on variation in production technology used, variations production process as well as variations in country specific environment.

There is a variety measure of efficiency based on availability of data (Krugman 2004). For example, GDP per hour worked has been widely used assess productivity of countries labour inputs. By labor input, we mean total hours worked of all workers engaged in production. However, this measure of efficacy has had criticism-based unavailability of large data requirement for its regression Krugman (2004). To Gordon, et al., (2015) organizations such as health care centers can improve their productivity/efficiency in output based on using three strategies[3]; PPE, TE and PPF

The Euler's theory of production as proposed by Beattie et al, (1995) explains the production process by relating input(s) for instance capital & labour abbreviated as L & K. to an output parameter Y. It states that suppose Y = (L, K) relates to a production function and factors of production are rewarded as per the marginal productivity, the total factor payment then will be equal to the magnitude of homogeneity of the production function multiplied by the output. Marginal productivity payment in value units exhausts total value of product. Physical units or value is used to measure the output. Yet another productivity concept is the Total factor productivity that seeks to measure both output and input size of an organization. According to

3

First by improving technical TE, which entails moving towards the production possibility frontier (PPF). The second strategy is advancement in technology and organizational change which can lead to expansion of output by more than any additional inputs that might be required. This is about an outward shift of PPF. Lastly by increasing returns to scale; which reflects in reduction in unit cost of production as outputs expand

Candemir et al., (2011) Total factor productivity growth index can be decomposed to two components: change in technical efficiency (TE) and technical change indices which then can give, at a glance, the efficiency of the organization, best for decision making.

Efficiency of a firm can be measured in two ways as proposed by Farrell (1957). One of the measures is technical efficiency, this denotes a firm's potential to secure maximal outputs given specific inputs, while allocative efficiency which is the other measure evaluates the capability of a production unit to utilize inputs in optimal proportions. Economic efficiency or cost efficiency is derived from technical and allocative efficiency. Organizations cannot be both technically and allocatively efficient if they do not deploy minimum aggregate of productive resources at a minimal cost to bring out a desired quantity of output. Achievement of cost efficiency is through the ability of the provider to utilize the least quantity of inputs necessary for processing, while mixing inputs such that the process secures the production of a desired output level with the minimal feasible costs (Patricia, et al., 2017) The two measures are further described below.

2.1.1 Technical Efficiency

TE estimates the percentage of actual output in relation to the potential output that is produced from the same inputs by a fully efficient DMU (u_i=0), with a value of 1 indicating actual output equal frontier output. The frontier output is obtained by estimating the technology parameter vector using econometric methods of linear programming techniques (Ben-Belhessen, & Womack, 2000).

Health care technical efficiency denotes the ability of an organization within the health care system to produce its chosen outputs given its resources. Contrarily to allocative efficiency, technical efficiency measures do not intend to assess the value of the outputs produced. Patricia et al, (2017) asserts that health facilities are deemed fully efficient if they can provide the

maximum feasible output, in consideration of the technology and factors of production or inputs available. Technical efficiency therefore denotes the ability of a provider to produce the highest possible range of outputs with the inputs availed to enable delivery of the outcome. Health facilities are deemed to be technically efficient in similar perspective when they use the minimal possible input mix during the production of the scheduled extent of output, considering the available technology.

Evaluation of TE seems less tasking relatively to that of allocative efficiency as it requires no prior specification of guidelines and, instead, is usually entirely an examination of whether the outputs produced by the entity under assessment were maximized, given its inputs and external factors. Comparative performance then lies at the center of most analyses of technical inefficiency (Cylus et al., 2017)

Input oriented measures of TE as described by Farrell (1957) looks at how inputs can proportionately be decreased without affecting the output. This measure answers the question "by how much can input quantities be lowered without affecting the output quantities produced?" (Coelli et al 2005). Output oriented measures looks at how output(s) can proportionately be expanded without expanding the input(s). DEA input-oriented model aims at the maximum possible proportional reduction in input usage with a given output levels. While output-oriented model is used with the objective of knowing whether maximum possible output is produced by the decision-making units with a given set of inputs. The output-oriented method focusses on the maximum possible proportional increase in output with a given set of inputs. Nonetheless, under the constant returns to scale assumption, the two models give the same findings in terms of technical efficiency index (Mehmet et al. 2011).

There are two categories as far as TE is concerned; Pure efficiency and scale efficiency (SE). Pure efficiency evaluates how inputs and outputs interact and relate while scale efficiency measures the scale of production. It assesses the extent to which a firm can decrease its inputs in fixed proportion while still remaining within the VRS frontier hence evaluates the DMU's overall success at utilizing its inputs.

Scale efficiency looks at the extent of optimal production such that if the size of the DMU is increased or decreased, efficiency drops (Yawe, 2010). measure of scale efficiency shows how close, 1n some sense, an observed DMU is to the optimal scale. In this case, the DMU is operating at constant return to scale (CRS) in that an increase or decrease in input proportionally leads to a similar increase or decrease in output. CRS model is appropriate when every DMU operates at optimal scale, the efficiency is defined as the maximum ratio of weighted outputs for weighted inputs subject to the condition that the similar ratio for every DMU be less than or equal to unity. (Charnes et al., 1978).

Variable return to scale (VRS) is a scale efficiency category where an expansion or reduction in input does not lead to a proportionate expansion or reduction in output. VRS takes the form of decrease return to scale (DRS) where percentage expansion in input result in less than proportionate expansion in output, while increase return to scale is where a percentage expansion in input results in more than proportionate expansion in output. VRS becomes more applicable where DMUs are not operating on optimal scale. A decision-making unit may exhibit pure efficiency and at the same time be scale inefficient, this could be as a result of its size.

2.1.2 Allocative efficiency

Allocative efficiency looks at how various inputs get incorporated to produce a combination of different outputs (Akazili et al., 2008). To achieve allocative efficiency (AE), inputs ought to be

in a way that costs are at minimum. A health facility for instance may use more capital than labor to produce an output or use more labor than capital to produce the same output. Compared to allocative efficiency, technical efficiency considers the extent to which an organization is capable of maximizing its output using a fixed amount of input resources, while allocative efficiency looks into the deployment of the right input mix for maximization of welfare as per societal needs.

Scrutiny of output and input choices can be done using allocative efficiency technique. The output choice explores whether available resources are deployed towards producing the right mix of health care outputs, on the other hand the input side informs decisions on what to incorporate or omit from the package of benefits provided (Cylus et al, 2017). Allocative efficiency can be examined from two angles; the health system angle and the societal perspective. A close look at the two may elicit a disconnect such that at the health system level where we have organizations like clinical teams, attainment of allocative efficiency may be elicited while an assessment on the wider societal perspective may reveal that there is misallocation of resources in between programs for instance from preventive to curative. This is usually done by key decision makers. In such a scenario, efficient teams will be working within an inefficient system (WHO 2017).

Considering that allocative efficiency factors in input price and price minimization, a DMU can be technically efficient but not necessarily allocative efficient. The concept of allocative efficiency looks at the right mixture of healthcare programs to maximize the welfare of the community. In health care services provision, Allocative efficiency may be reflected both at the microeconomic and macroeconomic level. In view of a sickness episode where inputs are the resources spent for his therapy, while output is the consequential wellbeing, the allocatively

efficient resolution is to manage the patient with the most cost-effective therapy regime at disposal. Efficiency concepts can feature at three levels; efficiency at the healthcare production level, consumption level and efficiency in choosing a level of healthcare.

Structurally, efficiency in allocation is attained when resources are distributed across different care interventions for instance; primary care, inpatient care, chronic illness and care, and rehabilitative care such that the bundle of services delivered maximizes the health gains produced by the overall health care system (EU, 2019).

Farrell (1957) described TE by an illustration of a DMU utilizing two sets of inputs (X1, X2) to produce an output Y in a constant return to scale input-oriented model.

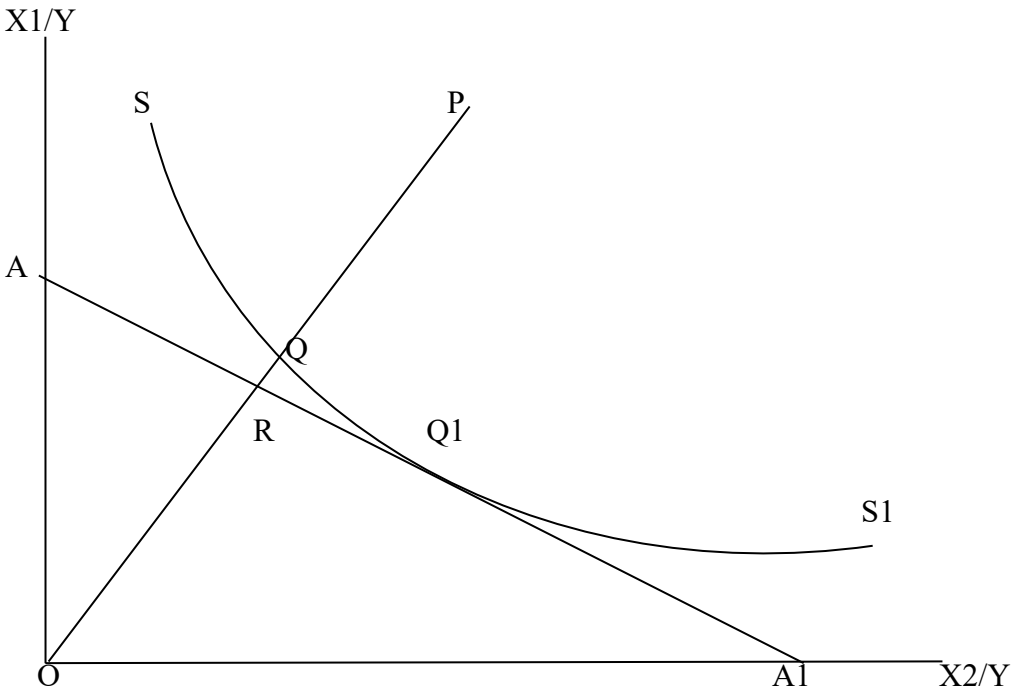

Figure 1: Farrell input-oriented efficiency measurement

The above figure explains technical efficiency in a DMU that uses 2 inputs, X1 and X2. For instances X1(Nurses), X2(Vaccines) for production of an output Y(immunizations). Along SS1, the DMU is fully efficient. Q and Q1 are at maximal production with varying inputs of X1 and X2. The firm uses inputs at point P to produce quantities out outputs at point P. TE of the DMU is OP/OQ. The line AA1 represents the price input ratio. Allocative efficiency (AE) is equal to OR/OP with RQ representing reduction in production costs. At Q1 the DMU is both technically and allocative efficient.

Other forms of efficiency measurement are; productive efficiency and economic efficiency. Productive efficiency looks at the best processes for delivering a given level of health interventions while Economic efficiency is derived from technical efficiency, productive efficiency and allocative efficiency where deployment of health inputs is determined by costs. The determination of efficiency by comparing service benefits with costs is key in allocative efficiency measurement (Makheti, 2017).

2.2 Empirical Literature

Many studies done on health care efficiency have been focusing more on hospitals while in primary healthcare settings, not much has been explored. Measurement of efficiency in the PHC environment appears to be more challenging owing to the holistic nature of service provision and the more generalist approach in supporting personal and family healthcare needs. This makes it difficult to define the confines of primary care output. (Hollingsworth 2008, Marghreta et al. 2021)

From a review of various studies, it is noted that application of DEA is frequently utilized in examining the efficiency of different private and public institutions, DEA is being preferred based on its linear programming ability producing feasible choices (Fatuma et al., 2021), while

others have used DEA jointly with SFA or with total factor analysis to take account of exogenous variables.

In Greece, Nikolaos et al, (2008) conducted a study to estimate the efficiency of rural health centers where Data Envelope Analysis technique was used. Input variables were technological equipment, nursing personnel and medical personnel, while the outputs were categorized as number of acute consultations, chronic consultations and preventive consultations. The results demonstrated a varying efficiency in the production process with technical inefficiency being the dominating form of inefficiency. Overall efficiency of over 0.9 was reported in 7.1% of the health centers while there was moderate efficiency of (0.7-0.9) in 23% of the health centers. Poor efficiency scores of (0.5-0.7 were noted in 31% of the health centers while 38.1% exhibited a very poor efficiency score of less than 0.5.

A study carried out in Madhya Pradesh-India by Jat & San Sebastian (2013) on the efficiency of district hospitals revealed that technical efficiency score was 0.90 with a standard deviation of 0.14 while scale efficiency score was 0.88 with a standard deviation of 0.15. 40 District hospitals were evaluated out of which, 50% were technically efficient. A mean score of 0.79 and 0.12 standard deviation was reported in the rest of the facilities which means they were inefficient, this meant that these facilities could reduce their output by 21% and still achieve efficiency with un altered input. 26 hospitals which account for 65% scored inefficiently on scale with an average score of 0.81and standard deviation of 0.16. Input variables used in the study were; doctors, nurses and beds capacity while output parameters were; total number of pregnant women completing the third antenatal care visit, total skilled deliveries, women receiving postnatal care within 48hours, number of medical termination of pregnancies, male and female

sterilizations numbers, inpatient admissions and number of outpatient consultations. Measurement of variables was done using data envelopment analysis.

Gonzalez-de-Julian, et al., (2021). estimated the efficiency of 18 primary healthcare facilities in Spain using factor analysis and data envelopment analysis jointly. For identification of the most explanatory variables to be incorporated in the models, factor analysis was used in the first stage. General practitioners' ratio, nurse's ratio and costs were used as input variables while output variables comprised of Consultations, emergencies, unnecessary hospital admissions, and prescription efficiency. Included as exogenous variables were the percentage of population over 65 and a multimorbidity index, while bootstrapping was used to calculate Confidence intervals. It is noted that introduction of exogenous variables through the various models plays a significant role in the identification of efficiency firms. In this study for instance, two models were established with model 1 having number of emergencies, avoidable hospital admissions and quality of prescriptions being introduced as the output variables while the general practitioner's ratio, nurse's ratio and ratio of pharmaceutical cost were the inputs. The second model used same inputs however there was a substitutes ratio of emergencies with an introduction of data on healthcare activities which was an aggregation of general practitioners and nursing consultations. The two variables were combined to form one variable "consultations". The results of the two models were averagely high with an efficiency score of above 90%. Model 1 gives an efficiency score ranging between 0.789 and 1 meaning that inefficient units have to lower their input intake ratio by around 2.9% to 21.1% to match their current output level. In model 2 where an aggregated input (consultations) was introduced, a significant improvement was noted overall except in one facility and there was an expansion in the number of facilities attaining fully efficiency from six to eight DMUs. Efficiency scores in this case range from 0.777 to 1.

Implying that a reduction in input ranging between 1% and 22.3% by the non-efficient units will lead to an efficiency gain.

Shri-Dewi et al. (2014) Malaysian study of 27 DMUs using data envelopment analysis, where quantity of hospital beds, number nurses and doctors were used as inputs while outpatients, inpatients, surgeries and delivery numbers were used as outputs. 20 of the DMUs which account for 74% were reported to be technically efficient. A TE score ranging from 0.780 to 0.991 was reported in the inefficient hospitals with an average of 0.935. On scale-inefficiency, hospitals scored a range of between 0.832 and 0.992 and average score of 0.938. This means that the inefficient facilities could reduce their input and still produce the same output.

Zhong et al., (2017) conducted a study on Chinese Primary Health Care institution's efficiency between the year 2009 and 2017, where efficiency of 86 PHC institutions was estimated using data envelopment analysis. The study used bed capacity, technical staff numbers and quantity of medical equipment with a value of more than 10,000 Renminbi (RMB) as inputs while outputs were hospital discharges, outpatient visits and emergency visits. The study reported an increase of TE from 0.559 in 2009 to 0.754 in 2014. A slight increase in TE was reported in 2017 after a decline in 2015. There were about 5% to 17% counties whose scale efficiency operated optimally with a scale efficiency score of 1.

In Chile, Martha Ramirez-Valdivia et al (2015) examined whether two approaches (DEA and SFA) could have different results in measuring efficiency. Primary healthcare centers in 259 rural and urban municipalities were evaluated. Inputs used were staff, general service and drug expenses while outputs were medical and check up visits. Both methods yielded similar results. Efficiency averages for SFA were 70.89% and 65.83% respectively for urban and rural municipalities while for DEA the averages were 68.37% for urban and 54.46% for rural. DEA

results in rural municipalities showed that scores for the inefficient DMUs varied from 8.54% to 18.29% and averages scores varying from 0.6109 to 0.7078. DMUs in urban municipalities had an efficiency range of 6.21% to 15.25% with average efficiency score ranging from 0.5117 to 0. 5615.

A Ghanaian study on efficiency of primary health in private and public facilities using DEA technique reported full efficiency in 31% of facilities in comparison to their counterparts. Various aspects could have accounted for these results the as study noted there was a high number of rural facilities (n=36) out of 64 sampled facilities, which could have skewed the efficiency score distribution. This is because most of the rural health facilities had fewer resources, nonetheless they recorded high facility turnout (Alhassan et al, 2015). The study variables were; medical staff, subordinate staff, observation beds capacity and number of consulting rooms as inputs while output factors were; deliveries, outpatient visits, antenatal visits and postnatal visits, family planning attendances, child and maternal health visits.

In Ethiopia, Tekle et al (2018) conducted a study on 16 public health centers in three districts. Clinical and non-clinical staff were used as inputs while the number of outpatient's visit, family planning, fourth ANC visits, delivery and pentavalent immunization were the outputs. The study reported an average technical efficiency score of 90% in 50% of the health centers implying that half of the sampled facilities were inefficient. This denotes that the facilities have a potential of maintaining their output with about 10% less of the inputs. The average scale score of inefficient DMUs was 89% meaning that there is possibility for expanding total outputs by about 11% using the existing resource envelope. A two-stage Data Envelopment Analysis was employed in measurement of the variables.

Kembo & Gwahola, (2015) studied the efficiency of private and nonprofit Teaching Hospitals in Tanzania, hospital bed capacity, doctors, nurses, and non-medical staff were used as inputs while output variables were; total inpatients discharged and total outpatient visits. Using Data envelopment Analysis approach, the results showed an average yearly mean scale efficiency of 78.5%, 83.8%, 83%, 84.1% and 82% for the five years from 2009 to 2013 respectively.

In another Tanzanian study, Fatuma et al. (2015) examined the scale efficiency of public hospitals using input-based data envelopment analysis. 19 regional referral hospitals and 114 district hospitals were included in the study. Beds and medical staff were used as inputs while inpatients and outpatients were the output variables. Efficiency scores of 1 were reported in 24 out of 114 district hospitals which accounted for 21.05%. This shows a scale efficiency of 100%, while inefficiency was reported in 78.95% of the hospitals. Among the inefficient facilities, 25 of had a scale efficiency of less than 0.5, while 24 hospitals scored between 0.51 and 0.70. The remaining 41 facilities accounting for 35.9% of the total DMUs had scores ranging from 0.71 to 0.99. Increasing return to scale (IRS) was reported in 87.8% of the facilities within the 90 inefficient district hospitals while 11hospitals exhibited decreased return to scale (DRS). On the regional referral hospitals, 3 out of 16 studied hospitals had a mean efficiency score of 0.786. while 43.75% of the regional facilities attained an efficiency score of 1. The 7 fully efficient hospitals had a constant return to scale meaning they were performing at their most productive scale. The remaining 9 hospitals obtained scores of less than 1, meaning they were below scale. Moreover, A score of less than 0.50 was reported in 2 hospitals, while 3 hospitals attained an efficiency score range of between 0.51 and 0.70. The rest 4 facilities had efficiency scores ranging from 0.71 to 0.99. All the 9 inefficient facilities exhibited increased return to scale (IRS)

implying that they are too small for optimal scale operation. For these facilities to at their most productive scale they needed to expand their scale of operation so as for them to attain the CRS.

Data envelopment analysis output-based approach was employed in measuring the level of technical and scale efficiency for 30 Health centers in Uganda by Tindimwebwa et al, (2018). Four input variables were measured which include; operational budget, medical personnel, non-medical staff and drugs, while five health center II outputs were used which include; immunizations, deliveries, antenatal care attendances, HIV/AIDS counseling and testing, and laboratory services. Results indicated that only eight facilities which accounted for 27% were deemed efficient. Efficiency scores of less than 1 were reported in the remaining 22 institutions with the least efficient DMU scoring 27.9%. The least efficient facility would need to potentially increase its service output by 72.1% for it to attain fully efficiency. For all the facilities, an average technical efficiency score of 72.3% was reported, this means that one health center on average could potentially improve its efficiency by increasing its outputs by 27.7%. A significant variation in TE scores however was generally observed with the least scoring 27.9% and the highest scoring 100%. From the CRS assumption the average efficiency score was 71.9% suggesting a slight reduction in efficiency with similar variations as technical efficiency.

In Kenya, several studies have been done to evaluate health care efficiency at various levels. Kioko et al., (2018) quantitative study on public hospitals reported a higher efficiency in small facilities compared to large facilities. Scores ranging from 74% to 91% were noted in small decisions making units (DMU) while in large DMUs, scores were ranging from 57% to 78% in. On regression analysis, results demonstrated that there was a negative correlation between efficiencies and hospital distance from the managers' residence. Suggested modalities for

improving hospital productivity were internal and external supervision. Data envelopment analysis was used to measure the variables. Three inputs were considered for the study, they include; beds capacity, doctors and nurses. On inputs, the study employed the total outpatient visits and total admissions.

Eric Bundi (2018) study of public health dispensaries in Imenti Sub- County Kenya, reported a scale inefficiency in 47% of the dispensaries, with their scores ranging between 60% and 90% and an average score of 62%, this means that if all the facilities were performing at optimal levels, then output would have been increased by 38% without positive alteration of the inputs. Approximately 35% of the DMUs exhibited decreased return to scale while 18% had increased return to scale, 47% for constant return to scale. The overall mean efficiency was 82%. DEA was used to analyze general outpatient visits, immunization, and maternal care as outputs while medical staff and support staff constituted the input variables.

In another study conducted by Makheti (2017) where 17 health centers in Meru County were evaluated for efficiency using data envelopment analysis. Clinical staff and support staff were used as inputs while maternal care visits and other visits. Results revealed an average technical efficiency of 45.2%, implying that the existing health care services can be increased by up to 54.8% without providing additional resources to the frontline health facilities. Data envelopment analysis was used in this study.

2.3 Overview of literature

From the various studies analyzed, it is clear that techniques currently employed in assessment of frontiers are generally categorized as parametric and non-parametric. Parametric methods include SFA and deterministic while DEA is a non-parametric approach. Most TE studies from available literature employ DEA because it allows analysis of multiple inputs and outputs.

Healthcare is an input in a production function for an individual's stock of health with an output of welfare. People need healthcare services to improve their health status. Healthcare facilities utilize different source inputs that include personnel, equipment, medical supplies and commodities. since health needs are unlimited and resources are scarce economists agreed to the need to improve on efficiency to produce maximum output from available resources at every level of care.

From studies carried out in various health facilities locally, and in countries regionally to globally on technical efficiency, varying levels of TE were noted even in DMUs with similar resources. Health care institutions globally and regionally particularly in SSA are reported to be operating inefficiently by majority of existing studies. This is happening as health indicators remain poor. Scale inefficiency is the most observed form of inefficiency hence resource redistribution and demand creation for health services is necessary.

CHAPTER THREE: METHODOLOGY

3.0 Introduction

This chapter presents the methodology the study will employ to achieve its objectives. Methodology refers to the techniques and tools the study employs to achieve the study objectives. This chapter covers subsections such as the study conceptual framework, economic models and estimation, model choice, data sources, sampling, data collection study area and population.

3.1 Conceptual framework

In the health production function, health facilities produce outcomes by utilizing numerous inputs like health care staff, vaccines, laboratory reagents to bring out numerous outputs, for instance immunizations, outpatient services and deliveries (Bundi 2018). The figure below shows the interaction between the inputs, processes and outputs.

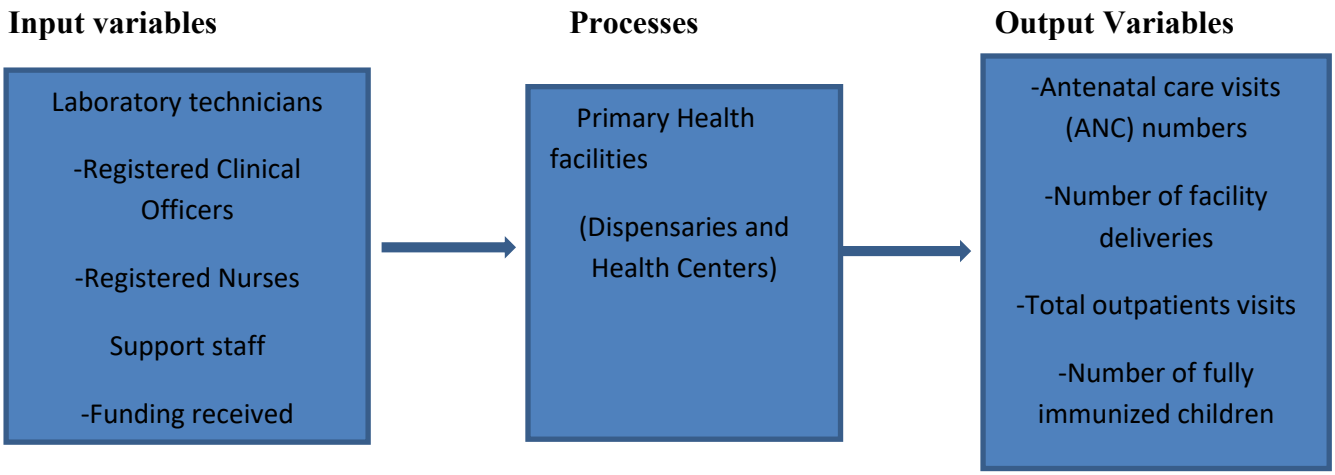

Figure 2: Technical efficiency conceptual framework

The analysis of efficiency and effectiveness is about the interaction between inputs and outputs. A Health facility is considered efficient if it produces the highest possible output using availed

quantities of input. It is imperative to find out means to expand the output by simply increasing the efficiency without adding more resources in healthcare (Farrell 1957, Vinaytosh M. 2018).

TE can be evaluated through an input-based approach or an output-based approach. Input-oriented model focuses on minimizing the input as output is maintained, while the output-oriented model aims at maximizing output with a constant level of input. For health facilities, input-oriented model is preferred because it determines the input mix the facility could reduce and maintain level of output. For the output model, health facilities might not have control because the decision of a client to use a particular facility is at the discretion of the client.

3.2 Economic models and Estimation

Ram Jat, & San Sebastian (2013) noted that there were two frontier analysis techniques which were regularly used for evaluating efficiency of healthcare institutions. They include; Stochastic Frontier Analysis (SFA) and Data Envelopment Analysis (DEA) which are described below. Other approaches incorporated in efficiency measurement are Ratio analysis and factor analysis.

3.2.1 Data Envelopment Analysis

Developed by Charnes, Cooper and Rhodes in 1978, DEA is a non-parametric method was that its output is an efficiency index that incorporates numerous inputs and outputs variables. It provides the required flexibility in frontier estimation such that a deviation from frontier is considered to be as a result of inefficiency.

DEA is a technique with a number of different interrelated perspectives and approaches utilized for measurement of comparative efficiency of a firm and for the estimation of the efficiency

frontier in a cluster of facilities with similar attributes. The CCR model with input orientation is the most widely used, it assumes a constant return[4] to scale.

The other model is the BCC (Banker, Charnes &Coopers). The input-output parameters are the same in CCR however they vary in BCC. Milan et al., (2009), argued that the CCR approach gives both input and output interpretation through solving one model while in the BCC approach, input model gives only an input interpretation hence a separate output model must be solved to give an output interpretation.

DEA approach has been advocated for evaluating health care facilities efficiency in set ups with inadequate health system information and limited data availability on cost of input (Ram Jat & San Sebastian 2013). The approach can also be utilized to gauge productivity and comparative efficiency of a facility among a group of facilities with similar structures and functions, like health centers.

DEA technique for efficiency evaluation has been described to accommodate a number of output and input variables within one measure of efficiency as opposed to stochastic frontier analysis which cannot (Charnes et al., 1995). By accommodating numerous inputs and outputs without the requirement for a common denominator of measurement, DEA is appropriate for analyzing the efficiency of health facilities as they use multiple inputs to produce many outputs. Moreover, it provides distinct input and output targets that would make an inefficient hospital relatively

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[4] A firm operates under constant returns to scale if an increase in the inputs results in a proportionate increase in the output levels. The model calculates the overall efficiency in which both pure technical efficiency and scale efficiency are aggregated into a single value (Martin, M., et al 2009).

efficient. It also recognizes efficient peers for those facilities that are not efficient thus helps the inefficient DMUs to benchmark from their efficient peers so as to improve. Akazili et al., (2008), observed that DEA technique does not suffer the drawbacks of multicollinearity and heteroscedasity as compared to SFA.

Gonzalez-de Julian (2021) acknowledged that using DEA permits for an estimation of efficiency that is geared towards realizing better results, proper dissemination and utilization of healthcare inputs. Nonetheless, its upon the health care managers to specifically identify the desired health system goals and the context within which efficiency evaluation is done as the results of efficiency are greatly influenced by the analysis perspective as well as the measured variables.

The model nevertheless suffers some limitations, Kirigia, (2013) pointed out that, DEA being a non-parametric technique, any departure from the production possibilities frontier is attributed to inefficiency, whereas some of the divergence from the frontier may be as a result of other factors such as; epidemics, civil war or natural disasters like flooding and earthquakes leading to displacement of people. Another shortcoming is that a facility may be deemed efficient amongst a set of homogeneous DMUs but inefficient in actual sense thus has the potential to justify inefficiencies. Since it's a non-parametric method, it can be difficult to undertake hypothesis testing.

3.2.2 Stochastic Frontier Analysis

This is a parametric[5] method which employs an econometric technique to measure a facility's efficiency. It establishes a frontier that permits for the likelihood of modeling and measurement error (Jat & San Sebastian 2013). Coelli et al, (2005) observed that incorporating exogenous variables which can influence the productivity of a firm that are not the main study variables in the process is critical for the analysis of efficiency. Geographical location and demographical aspects are some of the exogenous variables that might influence efficiency of a facility. The utilization of the SFA permits for estimation and testing the importance of the effects of exogenous variables on mean efficiency in one step. DEA and SFA are many a times used together to draw a comparison on findings.

Evaluation of cost efficiency by utilizing stochastic frontier analysis needs data on input prices, output quantities, and total expenditure on the inputs used. It is presumed that all health facilities seek to minimize costs, which is necessary as in the case of an underlying Cobb-Douglas production function (Coelli, 2005). The production frontier model is rooted on the Cobb Douglas production function as stated below

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5 The parametric nature of SFA allows for assumption of a given functional form for the interplay between the variables (Coelli et al, 2005). Obayelu et al., (2016), noted that SFA comprises of a production function with a composite error term equal to the sum of 2 error components. The first component accounts for random effects, otherwise referred as statistical or "white noise, while the second component represents systemic effects that are not explained by the production frontier but attributed to technical inefficiency. There is also possibility of conducting a hypothesis test on the inefficiencies scores with SFA technique.

Log y =βx + ν -μ

Where;

Y=the observed output/efficiency score

βx + ν= the optimal production function comprising of βx the deterministic part of the function and v is the stochastic part

μ=the inefficiency

3.2.3 Ratio analysis

Ratio analysis compares selected ratios[6] between an input and an output used in production process among a particular group of DMUs. This ratio can take the form of cost per day, cost per diagnosis and cost per bed among others. It is basically the average cost of production and not efficiency measurement in strict terms. The DMUs that realizes a given output at the minimum cost possible without affecting output quality is deemed efficient. The approach is simple to use and requires less expertise (Zere et al. 2005)

Some of the financial indicators used in ratio analysis include; operating margin, current ratio, debt to equity, debt per capita, revenue per client, and resource per capita. In as much as the ratios give critical information on the operations of the health institution in so far as forecasting

[6] In the hospital set up, there are a number of ratios that can be done using the balance sheets and income statements which can indicate the level of financial stability in the institution. Analyzing financial ratios is an important practice for health care institutions. The ratios show where operating costs are moving; they help manage cash flow and provide a great baseline for analyzing profitability. Financial ratio tracking is effective for everything from low-a level facility to a large hospital system including overall County health departments

and decision making is concerned, decisions drawn from the tool should not be taken in isolation. Knowledge on the organization's management and economic circumstances should also be considered.

3.2.4 Factor analysis

This is an analytical technique that build on the correlation analysis of multi-variables. Nadimi & Jolai, (2008) argued that the method is mainly applied for 2 purposes which are; for reduction of variable quantities, and the other purpose is detection of structural interrelation among variables. In this case, variables that correlate with each other are grouped together to form factors. Factor analysis can be used jointly with Data envelopment analysis to evaluate efficiency of DMUs (Nadimi & Jolai, 2008)

In the construction of DEA models, application of factor analysis comes first whenever the two techniques are used jointly. The relationship observed between variables and the explanatory nature of their variability determines the choice of the most suitable variables. This is done in consideration to the availability of the variables as well as interest of administration in the results of the DMU being evaluated. Factor analysis[7] permits for determination of variables that are most correlated with dimensions that have the greatest explanatory power of the variance and to

[7] (Nadimi & Jolai, 2008) noted that factor analysis has 3steps; the first step in factor analysis is generation of a matrix, which is a rectangular disposition of the correlation coefficients of the variables with each other, then step 2 is the extraction of factors from the correlation matrix based on the correlation coefficients of the variables follows. Lastly factors are rearranged so that the bond between the variables and some of the factors is maximized.

avoid, as much as possible, those variables that are correlated with each other (Gonzalez-de-Julian et al., 2008).

3.2.5 Choice of estimable model.

Data Envelopment Analysis technique was used to analyze collected data. DEA represents a linear programming technique used in evaluating relative efficiency of every production firm amongst fairly homogenous decision-making units (Anton, 2013). Using a combination of inputs and outputs, it sketches a production possibility curve (data envelope) and DMUs are scored between zero (0) and one (1). With zero denoting non efficiency and 1 indicating that the facility is fully efficient.

If a DMU has a single input and a single output technical efficiency (TE) is basically expressed as: *TE = Output / Input.*

In practical set ups where a health facility has inputs (funds, medical staff, medical equipment, pharmaceutical) and outputs (facility deliveries, immunizations, outpatient visits). The technical efficiency of a firm will be equated to the maximum ratio of total sum of weighted outputs to total sum of weighted input (Charnes et al., 1978)

Supposing we have ***n*** DMUs each with ***m*** inputs and ***r*** outputs, the relative efficiency scores for a test DMU ***q*** is obtained by solving the following input approach equation as fronted by Charnes et al., (1978)

$$E\boldsymbol{q} = \frac{\sum_{i=1}^{r} u_i y_{iq}}{\sum_{j=1}^{m} v_j x_{jq}} \longrightarrow max$$

$$\sum_{i=}^{r} u_i y_{iq} \leq 1,\ q = 1, 2, \ldots..n \quad (1)$$

$\sum^{m}_{j=1} {}^{v}j^{x}jq$

Where;

Eq – efficiency of q^{th} DMU,

yiq – output quantity *i* produced by DMU *q*,

xjq – input quantity *j* used by DMU *q*,

ui = is the weight given to output *i*,

vj= is the weight given to input *j*,

ε = is the constant which makes all weight of inputs and outputs positive.

The choice of the DEA method is based on its relative ease of application and superiority[8] in efficiency computation. For example, in comparison to stochastic frontier analysis, a DEA is superior in this study because it allows prediction of multiple outputs, it can also accommodate a smaller sample of DMUS and it avoids measuring prices of outputs which might not be in place for transactions of services and fee-based outputs. While SFA requires using a large number of DMUs, and it has to measure process of outputs

3.3 Sources of data, sampling, collection and coding

The study uses cross section data collected from county health records and The District Health Information System (DHIS2) reporting platform for the year 2019. DHIS2 is a web-based platform for electronic management of health information which enables the creation of digital

[8] 1). it is non-parametric and hence does not require functional form in advance, 2). it can handle small sample size, 3). DEA can decompose technical efficiency into pure technical efficiency and scale efficiency where technical efficiency (TE) = Pure technical efficiency (PTE) multiplied by Scale efficiency (SE).

forms and indicators. The unit(s) of analysis are health centers and dispensaries. The two units are non-homogenous hence their analysis will be done separately. Dispensaries being the lower level DMU offers outpatient services, Voluntary counselling and testing (VCT) services, Tuberculosis care and treatment, diagnostic services, child welfare clinics, antenatal and postnatal care, pharmacy services, counselling and referral services. For Health centers, on top of services offered by dispensaries, they offer daycare and inpatient services, HIV/AIDS comprehensive care services, cervical cancer screening, non-communicable disease clinics like diabetes, hypertension among others, maternity services. As per 2019, Mombasa County had 25 dispensaries and 12 Health centers (Mombasa County Government 2018). The study was conducted in 6 health centers and 12 dispensaries.

Facilities were clustered into their level of healthcare provision that is 1st level for dispensaries and 2nd level for health centers, then a systematic sampling technique was used to pick facilities from the sample frames in accordance to Hayes (2021) interpretation.

Input variables measured include; 1. Medical staff numbers (Clinical officers, Nurses and laboratory technicians). These are the frontline technical service providers found both in health centers and dispensaries. 2. Funds received, which includes allocation from county government in form of Health sector service fund (HSSF), free primary healthcare reimbursement, free maternity reimbursement, NHIF reimbursement, supporting partners like Danish International Development Agency (DANIDA), and cost sharing revenue for some facilities. 3. Number of support staff (Registration clerks, cleaners, cashiers) for the year 2019. These input variables were preferred because of their relevance in primary health care. For the output variables, the study uses 1. Outpatient visits which capture all consultation visits in the facility. number of fully immunized children, antenatal and postnatal visits, number of deliveries conducted by skilled

birth attendants within the facility. These outputs are key in contributing to healthcare outcomes indicators like immunization coverage, maternal and neonatal outcomes and overall utilization rate of primary healthcare services.

The data collected was coded in Stata version 15 which was used to run DEA model to estimate efficiency of the DMUs

3.4 Study Area

The study area is County Government of Mombasa in Kenya. The study will have a representative form its 6 sub-counties[9] and county assemblies. The Coast General Teaching and Referral Hospital is a tertiary level hospital in the County, and the only public level five hospital within the coast region hence its service catchment is stretched beyond the County. Lower-level public facilities include the Tudor, Port Reitz and Likoni sub county hospitals. There are also 12 Health centers and 25 dispensaries (Mombasa County Government 2018). According to the County Integrated Development Plan (CIDP) 2018-2022, Malaria is the leading cause of morbidity among the top five most prevalent ailments, accounting for 48% of the disease burden. The other cases in the top five bracket are common cold and flu contributing to 18.7 % followed by abdominal pain with an estimated prevalence of 5.2%. Respiratory infections are also common in the County with upper respiratory infections accounting for 0.7% while lower

[9] Mvita, Nyali, Changamwe, Jomvu, Kisauni, and Likoni and thirty county assembly wards. These are further sub-divided into thirty locations and fifty-seven sub-locations (Mombasa County Government 2018). The Kenya population and household census of 2019 reported that Mombasa County had a total population of 1,208,333.

respiratory infections having a 3.3% prevalence. Last in the top five is Diarrheal diseases which account for 2.3 per cent of all disease incidences in the county. The County's coverage for immunization stands at 73% with the high number of facility deliveries contributing significantly to this outcome.

Leadership and governance of the county's health department is guided by the constitution of Kenya 2010, where the county assembly committee on health is the top organ. Amongst the roles of the county assembly is the passage of budgets for funds allocation and coming up with bills on various forms of regulations. The level 4 and 5 hospitals have the hospital boards as governing organs while level 2 and 3 have the facility management committees. On leadership, the county health team is the topmost team that oversees implementation of policies and guidelines within the docket, down to the subcounty, we have the sub county health team and finally the hospital ad facility management teams that draw their members mostly from heads of departments.

Being adjacent to the ocean, the county has most of its economic activities pegged on Tourism and other blue economy ventures which support trade. An elaborate framework that enables different sectors such as the department of environment, the education sector, security, housing and urban development exists and works closely with the health sector to address fundamental health sector concerns that cannot be tackled solely by the health department but have an impact on the health of the population.

CHAPTER FOUR: ANALYSIS, INTERPRETATION AND DISCUSSION

4.0 Introduction

This chapter will focus on interpretation and presentation of the results of data analysis for both descriptive analysis and inferential estimates adopted by the model.

4.1 Specification of DEA model variables

The DEA adopts a model where a user needs to determine and select input and output variables from the dataset containing the attributes, options are dependent on the type of model one wants to fit, and the attributes needed for analysis.

The table below shows how the variables were distributed and to be used in the predictive analysis model. The variables are identified using the *ivars* for the input variables and *ovars* for the output variables, this is to enable the DEA command for the model to identify cases of multiple input and output dataset combinations.

An outline of the observed DMU has also been presented in the key table below with a prefix DMU (i) for each facility used in the analysis.

Table 5: Input and output parameters

Labels	Variables	Description
Input variables		
x1	Number of Staff	Total number of staff in the health facility
x2	Funds received	Total funds received for the financial year
Output variables		
y1	Children fully immunized	Total children fully immunized
y2	Total outpatients	Total Outpatients in the health facility
y3	Antenatal visits	Total Antenatal visits
y4	Deliveries	Total deliveries
y5	Postnatal visits	Total postnatal Visits in the facility

Table 6: Study sample DMUs

DMU	Health Facility
dmu:1	Kaderbhouy dispensary
dmu:2	State House dispensary
dmu:3	Majengo Dispensary
dmu:4	Bamburi Dispensary
dmu:5	Junda Dispensary
dmu:6	Shimo Annex Dispensary
dmu:7	NYS Dispensary
dmu:8	Marimani Dispensary
dmu:9	Bokole dispensary
dmu:10	Shika Adabu dispensary
dmu:11	Jomvu kuu dispensary
dmu:12	Miritini MCM dispensary
dmu:13	Shimo Main Health Centre
dmu:14	Jomvu Model Health Centre
dmu:15	Mbuta Model Health Centre
dmu:16	Mlaleo model Health Centre
dmu:17	Mikindani Health center
dmu:18	Mtongwe Health center

4.3 Descriptive statistics

The study sought to understand how the variable in the model were distributed by looking at various attribute. A summary of the basic variable descriptive statistics was determined. The results of the finding were analyzed based on whether the facility was a level 2 dispensary or level 3 health center as presented below.

Table 7: Descriptive statistics summary for dispensaries

Variable	Obs	Mean	Std. Dev.	Min	Max
Number of staff	12	10	5.359783	4	20
Funds received	12	2308917	2365985	258687	8003601
Immunization	12	532.9167	398.5206	134	1370
Outpatients	12	9212.25	6420.577	680	20967
Antenatal visits	12	676.3333	751.0428	14	2398
Deliveries	12	50.58333	107.2978	0	315
Postnatal visits	12	56.83333	115.5594	0	302

From the results above, there were a total of 12 dispensaries with an average of 676.33 antenatal cases reported within the dispensaries. The highest number of cases observed being 2398 while the least number of cases were at 14. On average the number of outpatient's visit were at 9212 while the highest number of outpatients recorded was 20967 and the lowest being 680. on the number of immunizations 532 was the average number of records while the highest immunization number being 1370 and lowest being 134. On funds received by the dispensaries, on average a firm received 2308917 with the dispensary with the highest revenue received being 8003601 and the dispensary which received the lowest was at 258687. The dispensaries had an average of 10 members of staff with the facility with high number of staff being 20 and the lowest being 4. The average deliveries and post-natal visits were 50 and 56 respectively.

Table 8: Descriptive statistics summary for Health Centers

Variables	Obs	Mean	Std. Dev.	Min	Max
Number of staff	6	17.33333	6.889606	8	28
Funds received	6	2209726	984824	809810	3837971
Immunization	6	551.8333	325.3462	213	947
Outpatient visits	6	12563.83	5915.586	2897	21150
Antenatal visits	6	542.8333	445.2138	153	1249
Deliveries	6	235.6667	217.6912	0	520
Postnatal visits	6	185.3333	209.6384	0	482

From the results above, there were a total of 6 health centers with an average of 542 antenatal cases reported within the facilities. The highest number of antenatal cases observed being 1249 while the least number of cases were at 153. On average the number of outpatient's visit were at 12563 while the highest number of outpatients recorded was 21150 and the lowest being 2897. On the number of immunizations 551 was the average number of records while the highest immunization number being 947 and lowest being 213. On funds received by the health centres, on average a firm received 2209726 with the health center with the highest revenue received being 3837971 and the health center which received the lowest was at 809810. The health centers had an average of 17 members of staff with the facility with high number of staff being 28 and the lowest being 8. The average deliveries and post-natal visits were 235 and 185 respectively.

4.4 DEA Efficiency Results

Computation of efficiency scores was done under the multi-stage DEA method. This method is invariant to units of measurements. The analysis was done under the assumption of variable

returns to scale (VRS) and constant return to scale (CRS). The advantage of the variable returns to scale premise is that it relaxes the assumption that all DMUs are operating at an optimal scale and allows for breakdown of efficiency into technical and scale efficiencies in DEA. The results of the data envelopment analysis are presented in summary tables below.

4.4.1 DEA Efficiency for Dispensaries

a) CRS – 2 Stage

For DEA analysis, the default specifies a constant return to scale (CRS) input oriented two stage DEA model with an optimal solution of efficiency score (theta). TE and scale efficiency scores for each dispensary can be found in the table below. Efficiency scores range from 0 for total inefficiency to 1 fully efficiency. from the results below, the dispensaries had an average efficiency score of 88%. 58% of the DMUs were fully efficient while the rest had an efficient score ranging from 48% to 86% meaning they are inefficient as indicated in the table below.

b) VRS – 2 Stage

Additional information is shown in the results on the variable return to scale (VRS) specification, efficiency scores for all DMUs change on a positive trajectory due to lack of slack in these cases. On performing efficiency estimates on the data using the VRS model, we deduce that each model created produces similar results and have no extreme value. All except two DMUs had an efficiency score of 1 with dmu4 and dmu12 having efficiency scores of 72% and 91% respectively.

Table 9: Efficiency scores summary for dispensaries

DMU	CRS_TE	VRS_TE	NIRS_TE	SCALE	RTS
dmu:1	0.863164	1	1	0.863164	-1
dmu:2	1	1	1	1	0
dmu:3	0.816451	1	1	0.816451	1
dmu:4	0.672028	0.720043	0.676983	0.933316	1
dmu:5	1	1	1	1	0
dmu:6	1	1	1	1	0
dmu:7	1	1	1	1	0
dmu:8	1	1	1	1	0
dmu:9	1	1	1	1	0
dmu:10	0.814182	1	1	0.814182	-1
dmu:11	1	1	1	1	0
dmu:12	0.487823	0.910117	1	0.536	1

VRS Frontier:

On comparison of the efficiency scores using the two methods, the table below shows variations in the scores with VRS having an improved efficiency score as compared to CRS with corresponding findings on increasing return to scale (IRS) and decreasing return to scale (DRS) per DMU.

Table 10: Efficiency Variation scores for dispensaries

DMU	Number of staff	Funds received	Immunization	Outpatient visits	Antenatal visits	Deliveries	Postnatal visits	CRS_TE	VRS_TE	SCALE	RTS
1	13	8003601	683	20967	546	0	0	0.863164	1	0.863164	DRS
2	6	1492549	237	13080	1810	0	0	1	1	1	-
3	5	1073813	348	5100	161	0	0	0.816451	1	0.816451	IRS
4	13	4037520	975	9863	825	0	0	0.672028	0.720043	0.933316	IRS
5	12	3663523	1370	13099	1136	0	0	1	1	1	-
6	20	4261539	983	15436	2398	315	302	1	1	1	-
7	5	435450	247	6927	32	0	0	1	1	1	-
8	4	415772	149	2300	247	58	65	1	1	1	-
9	17	3024235	641	15104	357	234	300	1	1	1	-
10	13	756082	378	6661	360	0	0	0.814182	1	0.814182	DRS
11	5	258687	250	1330	230	0	15	1	1	1	-
12	7	284235	134	680	14	0	0	0.487823	0.910117	0.536	DRS

4.4.3 Stage 2 regression analysis using the efficiency scores

Analysis using tobit regression method was performed to establish the determinants of efficiency gaps among DMUs, this method was used for the reason that the efficiency scores are censored at the maximum value of the efficiency score.

The tobit regression analysis used the efficiency scores as the dependent variables for possible influential variable candidate as shown below for both VRS and CRS.

The results show that for both VSR and CRS number of staff is positively related to the efficiency scores of DMUs while funds received are negatively related to the efficiency scores at 1% level of significance

Table 11: Dispensaries VRS Tobit regression

Tobit regression — Number of obs = 12; Uncensored = 2; Left-censored = 0; Right-censored = 10

Limits: lower = -inf, upper = 1

LR chi2(2) = 0.02; Prob > chi2 = 0.9876; Pseudo R2 = 0.0032

Log likelihood = -3.8445378

VRS_TE	Coef.	Std. Err.	T	P>t	[95% Conf.	Interval]
nostaff	-0.0040867	0.0364852	-0.11	0.913	-.0853808	0.0772074
fundsreceived	-4.85E-10	7.97E-08	-0.01	0.995	-1.78e-07	1.77E-07
_cons	1.335831	0.3833607	3.48	0.006	.4816501	2.190012
var(e.VRS_TE)	0.0963268	0.1189402		0.0061505		1.508628

Table 12: Dispensaries CRS Tobit regression

Tobit regression — Number of obs = 12; Uncensored = 5; Left-censored = 0; Right-censored = 7

Limits: lower = -inf, upper = 1

LR chi2(2) = 0.1; Prob > chi2 = 0.9507; Pseudo R2 = 0.0086

Log likelihood = -5.8280221

CRS_TE	Coef.	Std. Err.	T	P>t	[95% Conf.	Interval]
nostaff	0.0065886	0.0285916	0.23	0.822	-.0571175	0.0702947
fundsreceived	-1.77E-08	5.69E-08	-0.31	0.762	-1.44e-07	1.09E-07
_cons	1.026751	0.2609736	3.93	0.003	.4452656	1.608236
var(e.CRS_TE)	0.1053852	0.0772831		0.020566		0.5400192

4.4.4 DEA Efficiency for health centres

From the results of health Centers, the average efficiency score is 98%. 66.6% (4) of the DMUs are deemed to be fully efficient, while the remaining 2 (33.4%) facilities had 92.8% and 94.5% efficiency scores respectively. Among the 6 health Centre the most efficient DMU had a score of 1 with the inefficient facility having a score of 92.8%.

c) VRS – 2 Stage

For VRS model, efficiency scores for all DMUs change on a positive trajectory due to lack of slack in these cases, all except dmu15 had an efficiency score of 1.

Table 13: Efficiency scores results for health centres

DMUs	CRS_TE	VRS_TE	NIRS_TE	SCALE	RTS
dmu:13	1	1	1	1	0
dmu:14	1	1	1	1	0
dmu:15	0.945661	0.967409	1	0.977519	1
dmu:16	1	1	1	1	0
dmu:17	1	1	1	1	0
dmu:18	0.928241	1	1	0.928241	1

Table 14: Efficiency variation scores for health centres

VRS Frontier:

DMU	Staff	Funds received	Immunization	Outpatient visits	Antenatal visits	Deliveries	Postnatal visits	CRS_TE	VRS_TE	SCALE	RTS
13	20	3837971	235	21150	251	278	52	1	1	1	-
14	18	1944970	947	14268	947	436	398	1	1	1	-
15	18	1929735	213	13387	324	180	180	0.945661	0.967409	0.977519	IRS
16	28	2509169	666	13100	1249	520	482	1	1	1	-
17	8	2226700	884	10581	333	0	0	1	1	1	-
18	12	809810	366	2897	153	0	0	0.928241	1	0.928241	IRS

On VRS and return to scale results, DMU15 (Mbuta Model Health centre) and DMU 18 (Mtongwe Health Centre) were exhibiting increase return to scale meaning that they were too small for them to operate at the most productive scale. They needed to increase their scale of operation to achieve constant return to scale. The rest of the DMUs were on their most productive scale.

4.4 Discussion

The data analyzed from level 2 facilities (dispensaries) denotes that technical inefficiency still exists in the facilities despite the increase in resource allocation. This points to some level of resource wastage within the facilities. However, 58% of the dispensaries were found to be fully efficient (State house, Junda, Shimo Annex, Bokole, Junda, Jomvu Kuu, Marimani, NYS). While 42% had varying level of inefficiencies (Kaderbhouy, Majengo, Bamburi, Miritini, Shika adabu).

On scale efficiency, dispensaries had an average scale efficiency 91.3% implying that the facilities can decrease their size by 8.7% without affecting their output. DMUs 3, 4 and

12 (Majengo dispensary, Bamburi dispensary and Miritini MCM) were exhibiting increase return to scale meaning that they were too small for them to operate at the most productive scale. Meaning unit costs decrease as outputs increase (economies of scale). Therefore, they needed to expand their scale of operation to achieve constant return to scale. For DMUs 1and 10 (Kaderbhouy dispensary Shika Adabu dispensary), they had a decreased return to scale (diseconomies of scale), unit cost increase as output increase, denoting that they were too large to operate productively hence they need to decrease their size to operate optimally.

The variation in resource allocation and scope of care provision could have partly contributed to the inefficiencies. Despite dispensaries ranked at same level, disparities in resource allocation were noted, while some were receiving multiple support from the county and donors, a significant number had little support. the level of funding varied in terms of the absolute amount and sources of funding. The same applies to provision of services. The healthcare provision package was noted harmonized across facilities. some services like delivery were not offered in all the facilities.

For the Health centers, technical efficiency scores were generally high with most of the DMUs scoring one and the rest close to one. The average CRS score was 97.8%, Fully efficient DMUs were Shimo la Tewa main health center, Jomvu model health center, Mlaleo Health Centre, and Mikindani Health center while Mbuta Health centre and Mtongwe health centre scored 96% and 92% respectively. The VRS average score was 99.4%. The inefficient DMUs performance perhaps could have been attributed to their

geographical location and population density as for the 2 inefficient facilities were both located in far flung areas of Likoni sub county

On scale efficiency, 66.6% of the health centers were scale efficient, the rest (33.4%) exhibited increased return to scale, meaning that they were too small to operate optimally

Health centers which are the larger DMUs in this study were found to be more efficient in average than dispensaries with scores of 98% and 91% respectively.

CHAPTER FIVE: SUMMARY, CONCLUSION, RECCOMENDATION AND AREAS FOR FURTHER STUDIES

5.0 Summary

Devolution of health services coupled with other healthcare policies encourages need based approaches in resource distribution and community participation in resource distribution and use. The Kenya Essential Package for Health (KEPH) identifies key impact areas and interventions towards attainment of health for all while the devolved Human Resources Management (HRM) guideline policy of 2015, outlines procedures for recruitment and distribution, and remuneration of workforce. All these are geared towards improving efficiency.

In this regard, this study sought at measuring the technical efficiency of Health centers and Dispensary in one of the counties in Kenya (County Government of Mombasa County). More specifically, the study sought to obtain three objectives; first, we sought to investigate how resources distributed is done within the public Health Centers and Dispensaries in Mombasa County. Secondly, we sought to investigate the scale efficiency existing within public health centers and dispensaries in Mombasa County. And lastly, we sought to investigate the technical efficiency levels and variations within the public health facilities in Mombasa County. To achieve these objectives, we utilized the Data Envelopment Analysis and data from the County health records and District Health Information System (DHIS2) for the year 2019 in which a total of 18 primary health facilities were evaluated. In the DEA analysis, the output variables considered in our analysis included outpatient visits, deliveries, antenatal visits and postnatal visits while inputs considered were; number of staff and funds received.

From our regression analysis, the result reveals that dispensaries had an average constant return to scale (CRS) efficiency of 88% with the least efficient dispensary scoring 48%. The average

variable return to scale of the dispensaries was 96%, while the least efficient scored 72%. Scale efficiency of the facilities ranged from 56% to 100% with an average score of 91%. Health centers on the other had had an average CRS of 97% and VRS score of 99%. Their scale efficiency ranged from 92% to 100%, with an average score of 98%. The study recommends reallocation of resources and expansion of service output through creation of service demand for the inefficient facilities.

5.1 Conclusion

In conclusion, this study established that there existed some level of inefficiency both at dispensaries and health centers. The average constant return to scale efficiency among the dispensaries in Mombasa was about 88% while their average variable return to scale being 96%. For the health facilities, the scale efficiency ranged from 56% to 100% with an average score of 91%. Finally, the Health centers had an average CRS of 97% and VRS score of 99% while their scale efficiency ranged from 92% to 100%, with an average score of 98%.

The study however had some limitations arising from the number of inputs and outputs. 2 inputs and 4 outputs were employed in the study, however there are other variables that could have contributed to efficiency which were not incorporated due to unavailability of data, for instance information on medical equipment's, pharmaceutical and non-pharmaceutical products are some are some of the inputs that have an influence on service delivery hence have a bearing on the output. The method used in efficiency examination (DEA) has the potential of justifying inefficiency amongst peer facilities since a facility lying on the frontier are deemed efficient and it acts as a benchmarking tool. Complementary methodologies should be used alongside DEA such as regression to prescribe recommendations.

5.2 Recommendations

Based on our study findings noting existing inefficiency, various approaches ought to be put forward by the County Government of Mombasa more so measures that will see resources optimally used within the primary health care facilities. From the analysis, some facilities are deemed inefficiency because of their size, that is they consume have significant resources at their disposal yet the resources are not transformed proportionally to productivity gains, hence exhibiting diseconomies of scale. Such facilities are considered too large to operate efficiently. Similarly, some facilities exhibit what is referred to as increased return to scale where output expansion is associated with an input unit cost saving. With such a scenario, health resources ought to be redistributed such basing on efficiency metrics and mechanisms for monitoring be in place. Redistribution of resources that is based on needs is key in achieving efficiency.

From the data gathered, a variation in services offered was also noted in facilities that were classified at same level, for instance some dispensaries were offering deliveries while others did not. It is on this perspective that the study recommends harmonization of service scope in line with standard norms and national guidelines. The expansion of service scope in facilities that still offer limited services could also aid in enhancing their efficiency. Facilities that are ranked at one level should be able to provide standardized health services while resources to be allocated basing on output metrics

Demand creation for services through sensitization and mobilization using the community strategy is equally of value in realizing this goal. The community health volunteers can play a key role in informing their assigned households on the kind of services offered within their respective link facilities and fostering community participation in needs assessment that is key in

planning for healthcare. The County Government of Mombasa needs to strengthen existing community health structures and emphasize on the need for community and facility linkages.

Community health workers are a crucial link between level 1 and the rest of the health systems; however, their work is purely voluntary and there exists no universal approach to facilitate and support their routine activities. There is a need to have a performance-based benefit package for this category of workers to be established through a policy. This may encompass a monthly stipend for the volunteers after attaining agreed objectives. This approach will go along way in motivating the workers thus enhancing their performance and eventually contributing to efficiency gains.

Institutionalization of research on efficiency in the county is also important so that trends can be set and observed thus inform key decisions on management of resources. A policy should be in place to ensure that each subcounty has a research officer with clear roles and reporting mechanisms be in place.

5.3 Areas for further Studies

The Study evaluated efficiency in sampled dispensaries and health centers, accounting for 46% of the facilities. The facilities included offer basic health care services and in cases where specialized or advanced care is needed, referral is done, hence they do not work as stand alone. The lower-level facilities feed the upper-level facilities in circumstances where needed services cannot be offered or where the available infrastructure is not able to handle certain cases. There is need to conduct more studies on the efficiency of the referral facilities like the sub county hospitals and the county referral hospitals.

Vertical program areas like like Malaria control, Tuberculous and leprosy program and maternal health are critical and contribute significantly to the overall health care outcomes. These programs receive special attention when it comes to funding and other forms of resource allocation. The programs receive a significant support from donors. Therefore, it is important to evaluate their efficiency as programs thus will be able to determine whether there is value for resources. Evaluation of efficiency in this key program areas will also address the concerns of sustainability and transition to domestic support in the event of dwindling donor support or complete exit of the aid.

In measuring the efficiency of a health facility, several inputs may be considered, for instance health workforce, medical supplies and support networks. These factors once evaluated using a set of predetermined outputs give a certain level of efficiency, however it is equally crucial to look at the determinants of efficiency. Henceforth, there is need to study the determinants of efficiency across all levels of care. Various attributes such as cadre of facility manager, age of the facility manager, level of funding, distance from facility could be evaluated see whether they have an impact on the efficiency of a facility.

Technology advancement has been at the center of healthcare delivery with areas like diagnostic services, health information management, supply chain management, and peer-based case management and telemedicine. The lower-level facilities are also gradually seen to be embracing the technology more so in information management and other key services (e.g., scheduling of clinic visits, client and specimen referral, receiving laboratory results from focal laboratories). This shift is beneficial when it comes to decision making at the service delivery points and the

managerial level and it comes with a cost implication. Therefore, it is equally important to study the impact of technology on efficiency.

Primary health care in counties is under the direct supervision of the subcounty health management teams in respective sub counties. The teams are mandated to carry out periodic supportive supervision and together with the facility teams identify areas of improvement. Several aspects are focused, e.g., Clinical guidelines implementation, standard operating procedures in infection prevention and control, quality management, infrastructure management etc. the teams receive budgetary allocations on quarterly basis to enable them carry out their scheduled activities. There is also a need to evaluate their performance owing to the fact that they employ resources that need to bring output and value for resources.

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APPENDICES

Appendix 1: CRS Efficiency results for dispensaries

options: RTS(CRS) ORT(IN) STAGE (2)					
CRS-INPUT Oriented DEA Efficiency Results:					
	Rank	Theta	ref:1	ref:2	ref:3
dmu:1	8	0.863164	.	1.335	.
dmu:2	1	1	.	1	.
dmu:3	9	0.816451	.	0.0240775	.
dmu:4	11	0.672028	.	0.0500019	.
dmu:5	1	1	.	0	.
dmu:6	1	1	.	0	.
dmu:7	1	1	.	0	.
dmu:8	1	1	.	0	.
dmu:9	1	1	.	0	.
dmu:10	10	0.814182	.	0.0868594	.
dmu:11	1	1	.	.	.
dmu:12	12	0.487823	.	.	.
	ref:4	ref:5	ref:6	ref:7	ref:8
dmu:1	.	0.267595	.	2.81E-07	.
dmu:2	.	.	.	.	.
dmu:3	.	0.190127	.	0.331253	.
dmu:4	.	0.703029	.	3.95E-08	.
dmu:5	.	1	0	.	.
dmu:6	.	.	1	.	0
dmu:7	.	0	.	1	0
dmu:8	.	.	.	0	1
dmu:9	.	.	.	0	0
dmu:10	.	.	.	0.645548	0
dmu:11	.	.	.	.	0
dmu:12	.	.	.	.	.
	ref:9	ref:10	ref:11	ref:12	islack:nostaff
dmu:1	0	.	.	.	.
dmu:2	.	.	.	.	.
dmu:3	.	.	.	.	.
dmu:4	0	.	.	.	.
dmu:5	0	.	.	.	.
dmu:6	.	.	.	.	.
dmu:7	0	.	.	.	.
dmu:8	.	.	0	.	.
dmu:9	1	.	.	.	.
dmu:10	.	.	0.791856	.	2.8762

Appendix 2: VRS Efficiency results for dispensaries

options: RTS(CRS) ORT(IN) STAGE (2)					
VRS INPUT Oriented DEA Efficiency Results:					
	Rank	Theta	ref:1	ref:2	ref:3
dmu:1	1	1	1	.	.
dmu:2	1	1	.	1	.
dmu:3	1	1	.	0	1
dmu:4	12	0.720043	.	0.0095973	0.160432
dmu:5	1	1	.	.	.
dmu:6	1	1	.	0	.
dmu:7	1	1	.	0	.
dmu:8	1	1	.	0	.
dmu:9	1	1	.	0	.
dmu:10	1	1	.	0	.
dmu:11	1	1	.	.	.
dmu:12	11	0.910117	.	.	.
	ref:4	ref:5	ref:6	ref:7	ref:8
dmu:1	.	.	.	.	.
dmu:2	.	.	.	.	.
dmu:3	.	0	.	.	0
dmu:4	.	0.650314	.	.	0.174261
dmu:5	.	1	.	0	.
dmu:6	.	.	1	.	0
dmu:7	.	0	.	1	0
dmu:8	.	.	.	0	1
dmu:9	.	.	.	0	0
dmu:10	.	0	0	.	.
dmu:11	.	.	.	.	0
dmu:12	.	.	.	.	0
	ref:9	ref:10	ref:11	ref:12	islack:nostaff
dmu:1	0	.	.	.	0
dmu:2	.	.	.	.	.
dmu:3	.	.	.	.	.

Appendix 3: CRS – 2 Stage efficiency scores for health centres

options: RTS(CRS) ORT(IN) STAGE (2)					
CRS-INPUT Oriented DEA Efficiency Results:					
	rank	theta	ref:13	ref:14	ref:15
dmu:13	1	1	1	0	.
dmu:14	1	1	.	1	.
dmu:15	5	0.945661	.	0.938253	.
dmu:16	1	1	.	0	.
dmu:17	1	1	.	0	.
dmu:18	6	0.928241	.	0.386484	.
	ref:16	ref:17	ref:18	islack:nostaff	islack:fundsreceived
dmu:13	.	0	.	.	.
dmu:14	.	0	.	.	.
dmu:15	.	.	.	0.133333	0.0188705
dmu:16	1	.	.	0	.
dmu:17	.	1	.	.	.
dmu:18	.	.	.	4.18219	.
	oslack:immunization	oslack:outpatient	oslack:antenatalvisits	oslack:deliveries	oslack:postnatalvisits
dmu:13	0	.	0	.	.
dmu:14	.	.	.	.	.
dmu:15	675.526	.	564.526	229.078	193.425
dmu:16	0	0	.	0	.
dmu:17	0	.	0	.	.
dmu:18	.	2617.35	213	168.507	153.82

Appendix 4: VRS efficiency scores for Health centres

options: RTS(VRS) ORT(IN) STAGE (2)					
VRS-INPUT Oriented DEA Efficiency Results:					
	Rank	Theta	ref:13	ref:14	ref:15
dmu:13	1	1	1	0	.
dmu:14	1	1	.	1	.
dmu:15	6	0.967409	.	0.912306	.
dmu:16	1	1	.	0	.
dmu:17	1	1	.	0	.
dmu:18	1	1	.	0	.
	ref:16	ref:17	ref:18	islack:nostaff	islack:fundsreceived
dmu:13	.	0	.	.	.
dmu:14	.	0	.	.	.
dmu:15	.	0.0151175	0.072576	.	0.0315567
dmu:16	1	.	.	0	.
dmu:17	.	1	.	.	.
dmu:18	.	.	1	0	.
	oslack:immunization	oslack:outpatients	oslack:antenatalvisits	oslack:deliveries	oslack:postnatalvisits
dmu:13	0	.	0	.	.
dmu:14	.	.	.	.	.
dmu:15	690.881	.	556.092	217.766	183.098
dmu:16	0	0	.	0	.
dmu:17	0	.	0	.	.
dmu:18	0	.	0	0	0

Appendix 5: Data collection sheet

TECHNICAL EFFICIENCY OF PUBLIC PRIMARY HEALTH CARE FACILITIES IN MOMBASA COUNTY.

Data collection sheet

Facility Name……Level……

Sub-County……County…… Year

Input variables

Facility Staff	**Numbers**
Clinical Officers	
Nurses	
Laboratory technologists	
Support stat	
Total number of staff	
Funds received	**Amount in Kenya Shillings**
HSSF/Free primary/Free maternity	
Cost Sharing	
Partners	
Total Amount	

Output Variables

Measured Variable	**Number**
Total outpatient visits	
Number of fully immunized	
Antenatal visits	
Postnatal visits	
Deliveries	

Appendix 6: Data collection approval request

UNIVERSITY OF NAIROBI
SCHOOL OF ECONOMICS

Telephone: +254-020-3318262 Ext.28122
Telephone: +254-20-4913206
Email: economics@uonbi.ac.ke
Website: economics.uonbi.ac.ke

P.O. Box 30197-00100 GPO
04 Harry Thuku Road
Gandhi Wing, Room GW 210
NAIROBI, KENYA

12th October, 2020

NACOSTI
The County Government of Mombasa

RE: - RASHID NYANJE MWADZAME REG. NO. X53/13428/2018

This is to confirm that the above named is a Master of Science in Health Economics and Policy student in School of Economics, University of Nairobi.

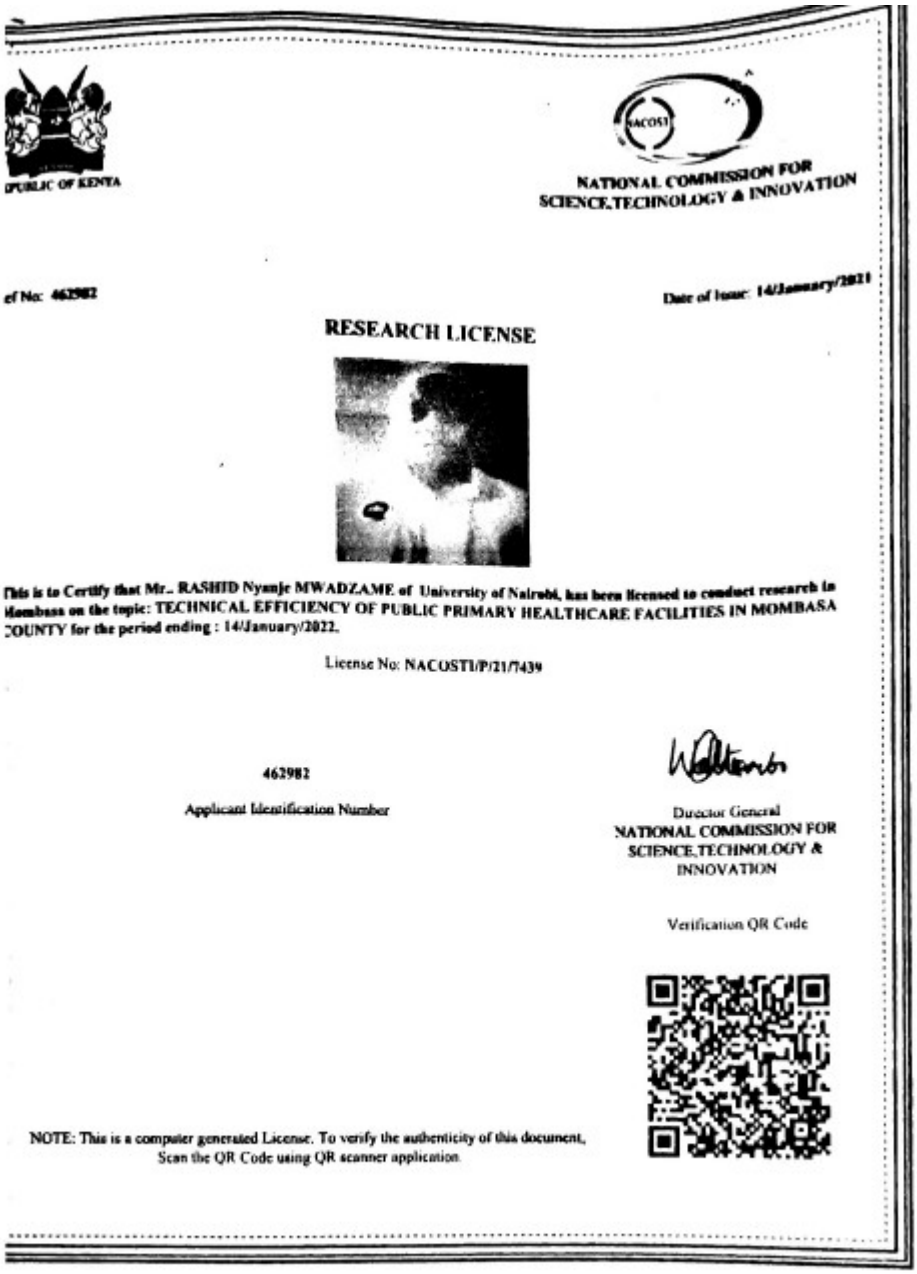
He has completed his coursework and currently working on his project titled: *"Technical efficiency of Public Primary Healthcare facilities in Mombasa County"*. He needs to collect secondary and primary data for the project to be satisfactorily completed.

We therefore request your kind consideration in providing him with any assistance he may require.

UNIVERSITY OF NAIROBI
SCHOOL OF ECONOMICS
P.O. Box 30197 00100 NAIROBI
Date:

David Wanjiru
Administrative Assistant,
School of Economics

Appendix 7: Research License



REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

ef No: 462982

Date of Issue: 14/January/2021

RESEARCH LICENSE

This is to Certify that Mr.. RASHID Nyanje MWADZAME of University of Nairobi, has been licensed to conduct research in Mombasa on the topic: TECHNICAL EFFICIENCY OF PUBLIC PRIMARY HEALTHCARE FACILITIES IN MOMBASA COUNTY for the period ending : 14/January/2022.

License No: NACOSTI/P/21/7439

462982

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

Appendix 8: Data collection approval letter

DEPARTMENT OF HEALTH SERVICES

OFFICE OF THE CHIEF OFFICER, PUBLIC HEALTH

Email : chiefofficerpublichealth2020@gmail.com

P. O. BOX 90441 - 80100
Msanifu Kombo Street
MOMBASA.

When replying please quote;

Ref. MCG/COPH/RSCH. /067

Date: 25th February, 2021

Rashid Nyanje Mwadzame
UNIVERSITY OF NAIROBI.

Dear Sir,

RE: AUTHORIZATION TO CARRY OUT A STUDY IN MOMBASA COUNTY

The Mombasa County department of Health Services is in receipt of your request to conduct a study titled "Technical Efficiency of Public Primary Health Care Facilities in Mombasa County" that received ethical approval from National Commission for Science Technology & Innovation and The University of Nairobi Institutional Ethics Review Committee.

The department is glad to grant you authorization to conduct your study over a period of three (3) months (expires **May,** 2021) in **Mombasa County** in line with the approved study protocol.

Upon completion of study, you are required to share your findings and recommendations with department of Health services, Mombasa County.

Sincerely,

COUNTY GOVERNMENT OF MOMBASA
CHIEF OFFICER
SIGNED 2021
P.O. Box 90440 - 80100

PAULINE OGINGA
Ag. CHIEF OFFICER PUBLIC HEALTH
DEPARTMENT OF HEALTH SERVICES
COUNTY GOVERNMENT OF MOMBASA