HEALTH EXPENDITURES AND CHILD MORTALITY:

EVIDENCE FROM KENYA

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DECLARATION

This Thesis is my original work and has not been presented for a degree in any other university

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ABSTRACT

In previous studies, health impacts of government and household expenditures have been estimated independently. As a result, the complementarities of these expenditures in improving health have remained unexplored. This thesis fills this gap by estimating own and joint effects of public and private health expenditures on child mortality using Kenyan household data supplemented with county level data. In particular, structural linear probability models of neonatal, infant, and under-five mortality are estimated accounting for potential biases due to endogeneity of expenditures and heterogeneity of child health.

A notable finding from the empirical analysis is that the effects of public and private health expenditures on child deaths depend critically on age of the child. In particular, public and private health expenditures have no effect on deaths of neonates but significantly influence the mortality of infants and children below the age of five.

In structural models of under-five mortality, effects of the interaction between the private and public health expenditures are statistically significant, suggesting that the expenditures complement each other in reducing child mortality. However, after accounting for the interaction effect, the separate impacts of the expenditures on mortality are statistically insignificant. Thus, in controlling childhood diseases, there is need for recognition that whereas the government should invest adequately to provide public health services, households should similarly provide for treatment of non-immunizable diseases. More generally, there is need to design and implement policies that promote synergy between public and private health expenditures in the control of all diseases.

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To you all, I say, thank you.

I am, however, solely responsible for any errors in the thesis.

LIST OF ABBREVIATIONS AND ACRONYMS

AIDS	Acquired Immune Deficiency Syndrome
BIA	Benefit Incidence Analysis
CFA	Control Function Approach
EU	European Union
FBO	Faith Based Organisation
FGM	Female Genital Mutilation
FIC	Full Immunization Coverage
GDP	Gross Domestic Product
GHE	Government Health Expenditure
GOK	Government of Kenya
HHE	Household Health Expenditure
HIV	Human Immuno-Deficiency Virus
HMIS	Health Management Information Systems
ICFMacro	Inner City Fund Macro International
IMR	Infant Mortality Rate
IV	Instrumental Variable
KDHS	Kenya Demographic and Health Survey
KIHBS	Kenya Integrated Household and Budget Survey
KIPPRA	Kenya Institute for Public Policy Research and Analysis
KNBS	Kenya National Bureau of Statistics
Ksh	Kenya Shillings
LPM	Linear Probability Model
MDGs	Millennium Development Goals
M&E	Monitoring and Evaluation
MICS	Multiple Indicator Cluster Survey
MOH	Ministry of Health
NGO	Non-Government Organization
NHSSPII	National Health Sector Strategic Plan II
OOP	Out of Pocket

RHHE	Residuals of Household Health Expenditure
TB	Tuberculosis
UNDP	United Nations Development Programme
UK	United Kingdom
UNICEF	United Nations Children's Fund
USD	United States Dollar
U5MR	Under-five Mortality
WHO	World Health Organization

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CHAPTER ONE: BACKGROUND AND CONTEXT

1.0 Introduction

Health has been the concern of many countries in the world for a long time. This is not only because it is important in general human capital formation, but also because the delivery of its inputs is complicated. Therefore, many developed and developing countries have been faced with a huge task of determining how to invest in healthcare for promotion of health. It has been noted that health formation starts at birth, and so, investments in health for an individual should start at birth.

An important socioeconomic aspect about health is that each person is endowed with a minimum amount of health at birth (Grossman, 1972). However, even at birth, health is not equitably distributed among individuals due to differences in socioeconomic status of parents, particularly the status of mothers, which affect birth weight, an important metric of health status (Rosenzweig and Schultz, 1993). As infants grow through life to become adults, health and its distribution at birth can be changed by policies and by health maintenance activities at the household level. The House of Commons (2009) report notes that each individual is born with a certain amount of 'physiological stock', which fluctuates over the course of an individual's life, improving and declining, due to health behaviors and health investments of individuals, families, and governments. The difference in health investments among individuals and households is an important source of health inequalities[1]. Theoretically, measuring health inequalities informs us about determinants of health as well as about its distribution. These determinants include

[1] The House of Commons (2009) report defines health inequality as systematic differences in health status between individuals and among socio-economic groups.

social, economic and political factors. Hence, health determinants narrow to such factors like per capita income; female literacy levels; government health expenditure; location of residence, among others.

Scholars and policy makers (e.g. Oleche, 2011; Mackenbach *et al.*, 2007; Maina, 2006) have been trying to link the enormous health inputs invested in the health sector across countries to the health outcomes realized at individual levels. This study contributes to the growing body of knowledge in this area by focusing on impacts of health inputs on child health outcomes in Kenya. Like in many other studies (see Nixon and Ulman, 2006; Subramanian and Canning, 2009), this study measures child health outcomes using neonatal, infant, and under-five mortality. Thus, this study investigates the impact of health expenditure (as an overall proxy for health inputs) through the lens of child health.

Health is the outcome of consumption of both healthcare and other goods and services (Grossman, 1972). The availability of the consumption goods and services is determined by economic, social, political, and environmental factors. These goods and services are however provided to populations in limited proportions, especially in low-income countries. This realisation may have informed the declaration of millennium development goals (MDGs), which cover various areas of human capital development. The performance of MDGs indicators in Africa, and particularly in Kenya, is wanting (KIPPRA[2], 2010; UNDP[3], 2010b). This could be because of low investment in MDGs-related sectors. For instance, there have been concerns on the resources and efforts devoted to production of health in the country. The per capita expenditure on health has

[2] Kenya Institute for Public Policy Research and Analysis
[3] United Nations Development Programme

remained far below any world recommended levels in most African countries[4]. Consequently, the state of health in Africa has deteriorated. The burden of disease has not lessened in many African countries.

For countries to realize health benefits there has to be purposive investments in health. This is because of the large benefits of health both as a consumer and as a producer good (Grossman, 1972). Its consumption yields utility and its investment is part of human beings (Schultz, 1961), which enhances production of goods and services. Health is produced from marketed goods and services like medical care, food, and nutrition, which have a direct influence on health. Government (public) and household (private) expenditures on health both lie in this category because they are direct inputs into the health sector. As expected, government investment in the health sector has a direct impact on the health status of the people. However, this does not mean that the interaction of government expenditure with society-wide variables and household socio-economic status does not matter for health.

In the United Kingdom (UK), it has been observed that the economic welfare status of a household has a direct impact on health status (House of Commons, 2009). The same case applies in Africa, where in low-income countries poverty adversely affects health. For instance, UNDP (2010a) reports that in 2010, about 1.75 billion people in 104 countries lived in poverty i.e., with at least 30 percent of welfare indicators reflecting acute deprivation in health, education, and material standard of living. The environments in which the poor live in, and particularly women, are normally wanting, especially in

[4] At the Abuja Summit in 2001, African countries agreed to allocate 15 percent of annual government budget to health. Only Rwanda and South Africa had achieved this by 2011 (WHO, 2011). Also, the World Health Organization (WHO) recommends that an allocation of United States dollar (USD) 44 per capita would be enough to cater for basic health services.

public health and hygiene. Women bringing up children in such environments face more challenges than those living in hygienic environments. This could be the reason why most of the health indicators in rural areas in Kenya depict lower than average life expectancy[5] (54 years in 2009); high maternal mortality (488/100,000 live births); high infant mortality (52 per 1000 live births in 2008); and high levels of disease burden (MoH[6], 2010a; KNBS[7] and ICFMacro, 2010).

Maina (2006) and MoH (2009a) suggest that the poor and especially the rural residents, have less access to healthcare due to unaffordable cost and long distances to health facilities. Access to healthcare implies both the physical availability of services and the ability of households to pay for the services. Though these two constraints (availability and ability) call for different policy interventions, their combined effect on a household is the same, namely, incapacity to afford either to access distant health services or to pay for nearby services or both.

Governments' investments in health have been an attempt to make health services accessible and available to everyone. Studies by World Bank (2009), Meessen *et al.* (2008), and Maina (2006) confirm that the non-poor households may be the main beneficiaries of government and donor subsidies to public hospitals, because poor households face many barriers in the utilization of health services. The poor are less likely to seek medical care when ill compared to the non-poor. However, the poor who seek treatment are more likely to use public facilities (such as clinics, hospitals and health

[5] Life expectancy is the summary measure of the age-specific mortality risks as observed in a particular period of time, and can be interpreted as the number of years that an average person could expect to live if he/she were to experience these age specific risks of dying throughout his/her life (Mackenbach *et al*, 2007).
[6] Ministry of Health
[7] Kenya National Bureau of Statistics

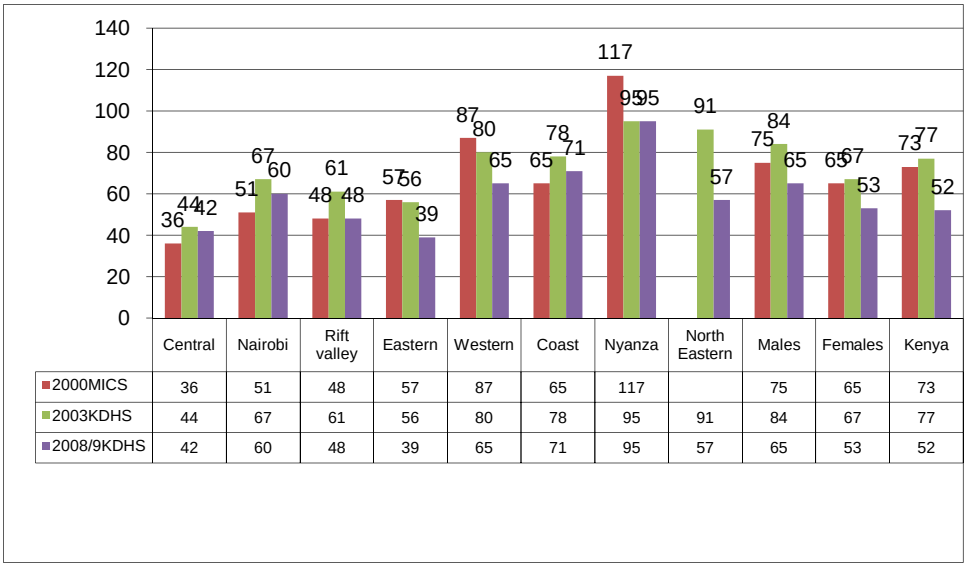
centres) than their non-poor counterparts; though a substantial share of the non-poor also use public health facilities. Due to lack of insurance-funded healthcare in Kenya, there has been substantial financing of healthcare through out of pocket payments by households (see MoH, 2009b, Oleche, 2011). This has been identified as a major barrier to accessing healthcare services by many poor households.

World Bank (2009) and Meessen *et al.* (2008) provide evidence that the poor face barriers to accessing even the public health facilities, which receive government subsidies. For instance, World Bank (2009) found that in Kenya, the poorest 40 percent get only 40 percent of the primary government subsidy. Currently, the government of Kenya (GoK) subsidizes healthcare for the under-five; however, it is not clear whether the gain by the poor from the subsidy is 100 percent. This being the case, the health outcomes for the children may remain wanting, worsening the health inequalities between them and the non-poor. The same holds for the different regions in the country. The poorer a region is, the greater the health inequalities are likely to be, hence the worse the health outcomes than the non-poor regions.

Government health allocations are geared towards ensuring that people have access to quality healthcare. Every year the government spends relatively huge sums of money on healthcare relative to other needs, as it tries to meet the health goals of affordable access to quality health care. However, the meeting of the goals has remained elusive. For instance, although the Government health budget allocation increased from 5.73 percent in fiscal years 2005/06 to 7.0 percent in 2009/2010 budget (GoK, 2010b), the basic health

indicators like life expectancy and child mortality[8] did not improve significantly. According to Kenya census reports (GoK, 2001; GoK, 2010a), life expectancy in Kenya improved from 54 years in 1979 to 59 years in 1989, but declined in 1999 to 57 years falling to around 54 years in 2009. The infant mortality rates (IMR) were at 52 and under-5 mortality (U5MR) at 74 per 1,000 live births as per 2008 demographic health survey. This is far below our 2015 MDGs targets of 26/1000 and 33/1000 for IMR and U5MR, respectively. It implies that the child health has not been improving at the same rate that the resources are being invested. The health outcomes in general show rural/urban and gender disparities and have unfavorable implications on access to healthcare. Figure 1.1 shows differences in mortality levels by regions.

Figure 1.1: Trends in infant mortality rate by province (various years)



	Central	Nairobi	Rift valley	Eastern	Western	Coast	Nyanza	North Eastern	Males	Females	Kenya
2000MICS	36	51	48	57	87	65	117		75	65	73
2003KDHS	44	67	61	56	80	78	95	91	84	67	77
2008/9KDHS	42	60	48	39	65	71	95	57	65	53	52

Data Source: KIPPRA (2010); KNBS andICFMacro (2010)

[8] Childhood mortality is measured per 1,000 live births. Childhood mortality in this case includes infant and under-five mortality

The main message from Figure 1.1 is that health inputs in Kenya differ by region, with important equity implications on child health outcomes. For instance, the IMR by province shows that Nyanza has been having the highest IMR for almost the last ten years. On the other hand, central province has been having the lowest rate during the same period. This implies that whereas one in every 10 children born alive in Nyanza will not celebrate their first birthday, in Central province, it is only one in every twenty three children born alive. That is, a child born alive in Nyanza is twice as likely to die before the first birthday compared to a child born in Central Kenya. However, it is yet to be established whether this is caused by low government or household expenditure in healthcare. Nevertheless, if these two regions were to invest the same amount of money in child healthcare, the impact on health outcomes is likely to be different.

Like in the case of infant mortality, there are regional disparities in under-five mortality. In 2008/9 for instance, Central province continued to register the lowest U5MR and Nyanza province the highest. Thus, a child in Nyanza province is more than three times likely to die before celebrating his/her fifth birthday relative to a child born in Central province, but twice as likely compared to a child born in North Eastern province (NEP). What determines these regional disparities in child health?

As Grossman (1972) notes, health outcome is determined by the investments made in healthcare to produce health stock. These investments are the inputs into the health production. In Kenya, health budgetary allocations and household health expenditures are the key inputs into the production of health. In 2009/2010, the health resources from the public (government), private (households, private companies and local foundations) and donor sources stood at 28.8, 36.7, and 34.5 percent, respectively (MoH, 2011). This

shows that households have been playing an almost equal role in promotion of healthcare as government. However, empirical studies have ignored this equal and complementary role of the households and government in the production of health.

1.1 Statement of the Problem

In Grossman (1972), consumers of medical services are perceived as not necessarily demanding medical services per se; what they look for when seeking medical services is good health. Grossman (1972) differentiates demand for medical services from the demand for health. Health is considered as a commodity that is produced through a combination of various goods and services, including medical care, food, physical exercises, time and housing, among other factors. In this case, medical care or expenditure becomes the health input that enters the health production function.

Medical care itself is a function of a number of factors, including availability of health facilities, human resources, drugs and supplies, among others. However, facilities alone cannot provide medical care without beds and other medical equipment. An important, overall health input is the availability of funds to purchase drugs, equipment and non-medical supplies that are needed at health facilities.

The funding for health in Kenya is provided by the households, government, development partners and the private sector. This implies that health expenditure is recognized as a key input to the production of health by all stakeholders. Households pay out of pocket expenses at the point of consuming medical care. At the same time, the government allocates funds to Ministry of Health to play its role in the production of health. In 2010/2011 financial year, for instance, the government health budget amounted

to Ksh[9] 44 billion (MoH, 2012). Thus, when the government and households allocate funds to health, this allocation is reflected in health indicators, which change depending on how effectively the resources are used. Whereas household health expenditures are on a need to need basis, government health allocations are assumed to be based on a number of factors, such as equity and general health status of a region.

The levels of infant and under-five mortality differ from region to region despite government budgetary allocations designed to promote health equity. For instance, a child born in Garissa is more likely to die before celebrating his first birthday than a child in Isiolo (KNBS and ICFMacro, 2010). This is despite the assumption that the health services provided in different regions of Kenya are adequate, and practically the same from region to region.

Government and household health expenditures across regions show significant differences. Some regions get substantially higher budgetary allocations than others. It is however not the case that the regions that get higher allocations have better health indicators. It could be that those with poor health indicators get more budgetary allocations than those with relatively good indicators as the government attempts to influence the production of good health in such regions. However, it is yet to be established whether it is the government expenditure and/or private health expenditure that plays a greater role in production of health in these regions.

This study assumes that the government and households are aware that any expenditure on healthcare is an input into the health production. However, government allocations to health may fail to make perceptible change in health indicators of poor people. Several

[9] Kenya shillings

scenarios are possible: first, the resources devoted to healthcare may not be adequate to lead to any significant change in health. Second, the resources may not be spent on the services that the poor consume. Third, there are other factors that negate the benefits of the services through these expenditures. These factors might include households' ability to interpret drug prescriptions, religious and cultural attitudes towards conventional and traditional medicines. Therefore, we can speculate that the pathways through which health expenditures impact on health outcomes are not clear cut. This is an empirical issue worth investigating and that is pursued in this thesis.

High regional disparities in health indicators necessitate an examination of the impact of government and private health expenditure on child health outcomes. This study measures effects of health expenditures on neonatal, infant and under-five mortalities. The underlying policy motivation for this investigation is that for effective policy interventions, there is need to understand determinants of a child's death at every age. There is evidence showing that the risk of death is higher close to the delivery date, and the causes of death near the time of birth are quite different from those later in infancy[10].

Whether health expenditures by household and government influence the observed child health outcomes is a theoretical as well as an empirical issue. It is theoretically known that health inputs (as might be proxied by health expenditures) matter for health (Grossman, 1972). However, the extent to which health differences in specific circumstances are driven by the differences in government and/or household health expenditures is an empirical issue. The regional differences witnessed in neonatal, infant

[10] http://www.deathreference.com/Me-Nu/Mortality-Infant.html. Accessed February 2012. As noted in some studies such as Kimalu (2002), child health is also a reflection of the status of health services in a community.

and under-five mortality in Kenya is happening against the backdrop of decreasing out of pocket health expenditures, and increasing government health expenditures. Many studies (e.g. Nixon and Ulman, 2006; Nolte and Mckee, 2004; Subramanian and Canning, 2009) have investigated health effects of private health expenditures independent of public health expenditure. However, in reality, as households spend on healthcare, the government is also spending on the same services. There is no evidence in Kenya on whether private or public health expenditures are more effective in improving child health when invested alone or when jointly invested. The health effect of joint expenditure on healthcare by households and government has been largely ignored in the literature. The major goal of this study is to fill this gap.

1.2 Research Questions

This thesis addresses the following questions using Kenyan data:

1. Do health expenditures by households and government have an independent impact on child health?
2. Do health expenditures by households and government jointly influence child health?
3. What other factors complement health expenditures in the production of child health?
4. How do effects of health expenditures vary by different measures of child health?

1.3 Objectives of the Study

The main objective of this study is to analyze the effect of health expenditures on child health.

Specifically, the research objectives are to:

1. Analyze the impact of household and government health expenditures on child health outcomes;
2. Examine the joint impacts of household and government health expenditure on child health;
3. Analyze impacts of demographic and human capital variables on child health;
4. Deduce policy implications from the study findings.

1.4 Justification of the Study

The overall objective of the health policy in Kenya as contained in various government policy documents (MoH, 1999, 2005; GoK, 2008) is to increase access to equitable, quality and affordable healthcare. The aim of the policy is to improve the health status of the populace. One strategy to meet this objective has been continuous increase in government allocations to healthcare. Therefore, it becomes important to conduct a study to examine whether the resources allocated to healthcare have any contribution to improvement of health status in the country.

Our study is informed by lack of evidence in the literature on pathways through which health inputs affect health outcomes. The availability of health resources alone may not guarantee improved health if the underlying causes of poor health are not addressed. For instance, to what extent does the environment under which health expenditures are made

matter for child health? This includes the environment of the mother during child birth and the bringing up of the child. This study is geared towards informing public policy on the need to consider the effects of non-health factors that may be influencing child health, even as medical efforts are made to save children.

There is dearth of information on the health impacts of government and household health expenditures on child health. This is especially so in relation to the effect of combined private and public expenditures. This study examines whether household and government health expenditures on their own have impacts on child health or it is their interaction that matters. Many existing studies have looked at the impacts of each of the expenditures independently, and cannot be used to determine how private and public expenditures influence child health. Since people use health services provided through both household and government health expenditures, there is need to examine health impacts of this joint expenditures.

CHAPTER TWO: THE KENYAN HEALTHCARE SYSTEM

2.0 Introduction

In this section, we explore the status of the health system in Kenya, especially the status of health inputs and health outcomes. Thus, this section presents information on the distribution of health facilities, the number of health personnel, immunization coverage, financing levels, and the health outcomes indicators.

2.1 An Overview

The healthcare system in Kenya consists of providers, financiers, regulators and consumers of healthcare. These different stakeholders fall either under the government or the private sector[11]. The government is constitutionally tasked to ensure that all Kenyans access quality healthcare equitably and cost effectively. The government and the private sector provide health services through their health facilities. These facilities range from rural health centres or clinics to national referral hospitals. The government controls slightly below 50 percent of the facilities (MoH, 2010b).

The financing of health services is done by different players. For instance, the government finances public health services through tax revenues and the support received from development partners. This is mainly for recurrent and development expenditures. However, there is normally a large gap between the amount of funds available and the amount required. This gap is filled by households through out of pocket payments or their

[11] Private sector in this case includes players that seek to make profit as well as the not-for-profit that include religious organizations and non-governmental organizations (NGOs).

medical insurance. In private health facilities, financing is mainly through fees collected from households visiting the facilities or through their medical insurance. This makes private health services more expensive than the government health services; hence access is limited to those who can afford the fees charged. It is well pronounced in various government policy documents that one of the aims of the national health policy is to provide all Kenyans with equitable and accessible quality healthcare (GoK, 2008; MoH, 2005, 1999). However, access to healthcare may differ by region and socio-economic group because of factors like disease burden, resource constraints and infrastructure development.

To ensure provision of quality healthcare, the government has put in place mechanisms to regulate the health professionals involved in providing healthcare services. This is through their professional bodies like the Kenya Medical Association (KMA) and also through legal frameworks that have created several bodies like the Medical Practitioners and Dentists Board; Pharmacy and Poisons Board; Clinical Officers Council among others. The medical practitioners' board licenses all doctors who are providing health services in both public and private healthcare facilities. Besides, the board licenses all health facilities providing healthcare to the public. This is aimed at ensuring that the services provided by the health professionals and their facilities are of the same standard.

However, despite all these elaborate health systems of provision and financing of healthcare in Kenya, there are myriad challenges facing the health sector. They include the increased burden of diseases facing households; low per capita budgetary allocations (approx USD13[12] in 2010/2011); lack of enough medical personnel; and scarcity of

[12] 1 USD = Ksh 80

essential drugs and supplies (MoH, 2012). This scenario seems to be contributing to the poor health outcomes as evidenced by how far the country is from meeting its MDGs targets in health. It is in light of these challenges that the households' out of pocket payments in health remains high as the government continues to search for an implementable health financing strategy. This study seeks to analyze whether what the household and government invests in health has any impact on health outcomes.

2.2 Health Inputs

The health inputs we analyze in this section include finances, distribution of health facilities, health personnel, and immunization coverage.

2.2.1 Health Facilities

Among the most important health inputs is the health infrastructure. This is because medical care services are offered at health facilities. This infrastructure includes the health facilities used for the provision of healthcare. In Kenya, given the pluralistic nature of the health system, health facilities are owned and run by the government and the private sector. These facilities range from specialised hospitals and clinics to nursing homes and dispensaries. In the government system, the health centres and dispensaries are very important as they provide the first contact of healthcare provision before referral to the hospitals. They are currently highly subsidized to promote access by the low-income earners and rural residents. In addition, they provide preventive and promotive healthcare. However, hospitals as a category become important because it is at this point

that healthcare consumers can access specialized treatment after referral from dispensaries and health centre.

The presence and location of a health facility in Kenya is very important because of the pyramidal referral system. Besides, resources in the health sector are distributed according to the existing facilities. Hence, a province normally has one provincial hospital, while a district normally has one district hospital and a number of health centres and dispensaries. This is irrespective of the population and the expansiveness of the region. For instance, Rift Valley General Provincial Hospital in Nakuru is supposed to serve Lokichogio residents in Turkana district, which is more than 700 kms away; and Embu Provincial General Hospital that is supposed to serve Moyale town residents, 900 kms away!

In a situation where a district does not have a district hospital, there is likelihood that there will be no doctor in the whole of that district because a doctor cannot serve in a health centre or a dispensary, which are managed and run by a clinical officer and nurse, respectively. The distribution of health facilities therefore indicates the easiness or the difficulty of accessing healthcare. The more difficult it is, the less the number of people who will access healthcare and the poor the health status is likely to be in that region.

On the other hand, the non-government sector has no systematic referral pattern because they focus on catchment areas. Thus, one region may have a higher concentration of health facilities because of a combination of factors given the different healthcare providers. The number of health facilities has been increasing over time, especially from the year 2003 when the Constituency Development Fund (CDF) was put in place and has been appreciated for its contribution in setting up health infrastructure. The challenge has

only been the standards, staffing, and stocking the health facilities with the required resources to make them fully operational.

The number of health facilities in Kenya reached about 8,006 by the year 2011 as shown in table 2.1. This was an impressive increase by 43 percent since 2007. The analysis of regional distribution of these facilities shows that 26 percent are in the Rift Valley province, followed by Eastern and Central with 18 percent each. North Eastern has the lowest number at 3.5 percent followed by Nairobi province at 6.3 percent (GoK, 2012). The distribution of these facilities shows the status of access to health services and has a dimension about the expected situation of health outcome in a particular region.

Table 2.1: Number of government health institutions by region

Province	**2007**	**2008**	**2009**	**2010**	**2011**
Nairobi	347	387	406	423	505
Central	556	1,199	1,251	1,345	1,413
Coast	717	723	770	754	852
Eastern	1,079	942	1,106	1,256	1,441
N/Eastern	164	198	232	264	278
Nyanza	761	716	773	745	932
Rift Valley	1,573	1,648	1,732	1,867	2,076
Western	392	377	426	457	509
Total	5,589	6,190	6,696	7,111	8,006

Source: GoK, 2012

Analysis of ownership and control of health facilities (see appendix Table A1) shows that by 2009, the private sector controlled 54 percent of the facilities while the government, through the MoH, controlled 46 percent (MoH, 2010b). However, government run facilities have a higher bed capacity than the private sector facilities. This implies that public health facilities are on average larger than the private ones. Ownership becomes very important in provision of healthcare because some services are subsidized in government facilities whereas they are not in non-government facilities. For instance, currently, the registration charges in dispensaries and health centres are Ksh 10 (USD 0.15) and Ksh 20 (USD 0.3), respectively. Children under five years are also supposed to receive free healthcare in government health facilities. This is not the same in most private-for-profit facilities where charges are at market prices. This therefore has an implication on the child health outcomes, especially in areas where government facilities are limited.

When one considers the population served by the facilities in each province, the impact on health outcomes becomes clearer. For instance, whereas Rift Valley had the highest number of health facilities (24%) in 2006, about 14 health facilities were shared by a 100,000 population in this province (see table 2.2). This was lower than Central province, which had 18 percent of the facilities but a higher number of facilities, 20 per 100,000 populations (MoH, 2007). This shows that there is more congestion in Rift Valley because of the high population being served by those facilities. This affects the quality of healthcare provided, hence health outcomes.

Table 2.2: Health facilities by agency and province, 2006

Province	Control	Nairobi	Central	Coast	Eastern	North Eastern	Nyanza	Rift Valley	Western	Kenya
Hospitals	GoK	5	8	9	15	4	13	21	10	85
	Missionary/ NGO	7	15	2	16	-	9	15	10	74
	Private	11	10	10	4	-	13	19	1	68
Sub-District Hospital	GoK	-	8	7	14	6	20	13	5	73
Nursing Homes	Private	27	26	23	26	3	35	24	27	191
Health Centres	GoK	23	51	32	70	8	72	138	65	459
	Missionary/ NGO	50	5	2	11	-	48	40	16	172
	Private	3	3	1	2	-	7	5	-	21
Dispensaries	GoK	18	222	152	302	63	183	489	74	1,503
	Missionary/ NGO	26	98	55	117	1	45	184	20	546
	Private	57	8	9	16	-	12	84	17	203
Clinics	Private	141	487	294	301	61	79	211	160	1,734
Grand total		**368**	**941**	**596**	**894**	**146**	**536**	**1,243**	**405**	**5,129**

Source: MoH, 2007

Whereas the distribution of government health facilities takes into account the distribution of administrative districts and provinces especially because of the government facilities referral system, the private facilities do not follow any systematic structure during their establishment, but naturally set up their facilities in high catchment

areas like urban centres. The not-for profit facilities established by non-government organizations (NGOs) and faith-based organizations (FBOs) mainly locate where they perceive a need. This therefore explains why one region may have a higher distribution of facilities than another because of a combination of factors determined by the different healthcare providers. The distribution of government healthcare facilities also determines how resources like drugs and medical supplies are shared because other than the salaries of the health professionals, the other resources are distributed as per the existing facilities. This affects both demand and supply side factors in access to healthcare, which has an impact on prevalence to diseases in different regions and therefore the healthcare. For instance, Central province had among the highest number of health facilities and leads in high life expectancy. Although this is an empirical issue, we noted earlier that relative to other regions, access to health facilities in Central province is not a problem and hence, the high life expectancy. However, North Eastern Province, which has the least number of health facilities, has higher life expectancy rates than some provinces. This may point to the existence of other factors other than resources that may be influencing health outcomes.

2.2.2 Distribution of Medical Personnel

The role of skilled health workers has been acknowledged as key to the reduction of childhood mortality and a boost to health outcomes. Access to good healthcare depends on availability of qualified physicians. The MoH developed human resource norms in 2006 to ensure an adequate and appropriate workforce for the workload and vice versa (MoH, 2010a).

The norms and standards determine how the healthcare workers are distributed across facilities in Kenya. Therefore, medical personnel are distributed according to the level of facilities. For instance, doctors run specialized clinics at the district hospitals (level 4); specialist doctors are concentrated at the provincial hospitals (level 5); nursing staff provide the first line contact services at dispensaries (level 2); clinical officers provide the first referral level for outpatients, managing those referred by nurses. Hence, the more dispensaries and health centres a region has, the more the nurses and clinical officers, respectively. Also, the more districts a region have, the more the doctors.

Table 2.3 shows the growth of medical personnel by type for the period 2003 to 2010 and represents those that have been trained in the respective specialties. The number therefore includes medical personnel who are in management, administration and self employment and not necessarily those practicing. Between 2003 and 2010, there was a gradual increase throughout the period. However, the health personnel to population ratios did not change much, especially in some cadres. For instance, the medical personnel to population improved from 528 people served by one medical personnel in 2003 to 388 people in 2010. During the same period, 6,661 people were served by one clinical officer in 2003 compared to 4,535 in 2010. The situation improved for doctors and pharmacists but not for dentists because one health professional from each of the category served 6,648; 17,012; and 41,450 in 2003, which later changed to 5,470; 12,592; and, 43,429 in 2010, respectively. The ratio still remains very high and therefore has an implication on the congestion and consultation fees in health facilities.

Table 2.3: Growth of medical personnel by type

Year / Type	2003	2004	2005	2006	2007	2009	2010
Doctors	4,813	5,016	5,446	5,889	6,271	6,800	7,129
Dentists	772	841	871	898	931	859	898
Pharmacist	1,881	2,570	2,637	2,697	2,775	2,921	3,097
Pharmaceutical Technologists	1,405	1,620	1,656	1,680	1,680	1,950	2,233
Bsc Nursing	-	-	-	-	-	863	988
Registered Nurses	9,869	10,210	10,657	10,905	12,198	26,988	29,678
Enrolled Nurses	30,212	30,562	31,895	31,917	31,917	34,032	34,282
Clinical Officers	4,804	4,953	5,059	5,285	5,797	7,816	8,598
Public Health Officers	1,216	1,314	1,388	1,457	1,682	7,192	7,429
Public Health Tech	5,627	5,861	5,938	5,969	5,969	5,969	5,969
Total	**60,599**	**62,947**	**65,547**	**66,697**	**69,220**	**95,390**	**100,301**

Source: Government of Kenya Statistical Abstracts, various (HMIS[13] data)

The Kenya Demographic and Health Survey (KDHS) 2008-2009 show that skilled birth attendance improved marginally from 42 percent in 2003 to 44 percent in 2008-2009 (KNBS and ICFMacro, 2010). However, this is still very low given that over 50 percent of births are not attended to by skilled personnel, yet there is evidence that skilled assistance during childbirth influences birth outcome, especially management of birth

[13] Health Management Information System

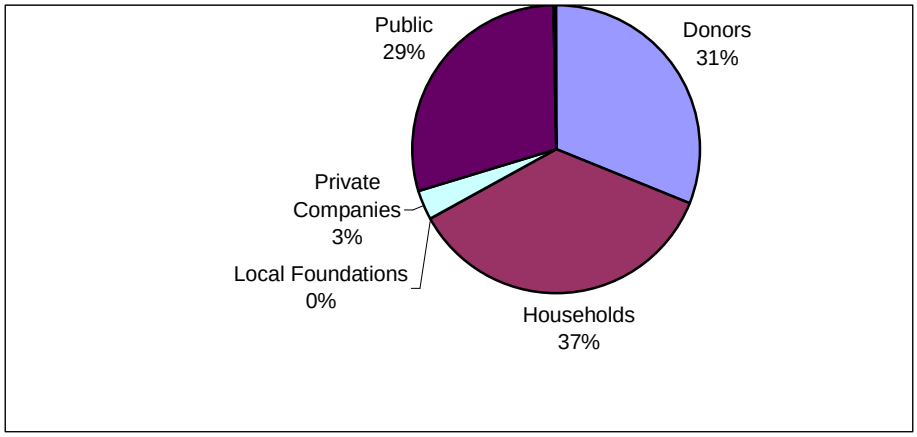
complications and observance of hygienic practices, hence the health of the mother and the child.

The above analysis shows that the country has a scarcity of health professionals. The implication is that the country is likely to continue experiencing poor health indicators. Therefore, for the country to be able to provide quality healthcare to its population, it may need to expand and increase the number of health personnel. This will therefore require adequate resources from all the stakeholders.

2.2.3 Health Financing

Health infrastructure, personnel, and drug and supplies, require to be financed in adequate amounts across all counties in order to achieve equity in health outcomes throughout the country. As mentioned earlier, financing is a key input into the health production function of a household or a country. There are several sources of health financing in Kenya, as highlighted in MoH (2009b). The major ones include households (37%); donors (31%); government (29%) and private companies (3%) (See figure 2.1).

Figure 2.1: Sources of funds for health financing in Kenya in 2005/06



Source: MoH (2009b)

Government funds are allocated to the MoH for recurrent and development expenditure, which includes remuneration of health personnel, purchase of drugs, medical supplies and infrastructure development. However, the contribution of the government (29%) has been lower than that of the households (37%) through out of pocket (OOP). Therefore, the contribution of each player in health financing has a lot of implication on access to healthcare. For instance, with over 37 percent of healthcare burden borne by households, it implies that many are constrained from accessing healthcare. The high out of pocket payment is as a result of the change of government policy from free healthcare to a cost sharing policy, where households pay for their healthcare at each hospital visit. Also, the charges demanded in both private and government-run facilities, make households the biggest financiers of healthcare in Kenya. Given the financing arrangement, is it likely that a household diverts its resources from say food to healthcare? The irony is that drugs can only be effective if taken with food. Thus, do we have cases where expenditure in

healthcare is ineffective because of lack of other resources like food? Should the government therefore provide drugs and households provide food and/or proper diet?

The total contribution of the government's finance to healthcare for the last three or so years is shown in Table 2.4. The aggregate financing level of the MoH stood at about Ksh 44 billion (approximately 4% of government budget) in 2010/11 financial year. This represented a 28 percent increase from 2008/09 levels. However, this was still below the global financing commitments that the government has undertaken. This includes the Abuja declaration of allocating 15 percent of government budget to health.

Table 2.4: MOH Total recurrent and development expenditure (Ksh million)

	2008/09	**2009/10**	**2010/11**
Compensation to employees	14,368.2	16,294.8	20,324.4
Use of goods and services	8,759.4	9,586.7	8,821.1
Grants, transfers and subsidies	7,515.2	6,769.4	9,769.8
Acquisition of non-financial assets	846.0	3,838.4	5,185.25
Total expenditure (Gross)	**31,888.8**	**36,489.3**	**44,100.6**

Source: MoH (2012)

In Kenya, the recurrent and development health expenditures amounted to about 4% of the government budget in the year 2010/2011. This translates to per capita allocation of about USD13, equivalent to Kshs 1,100 per person per year (MoH, 2012). Also, from the

allocation, a large proportion goes to recurrent expenditures, most of which cover personnel emoluments. The implication of this pattern of funding manifests itself in poor quality services and frequent shortages of essential inputs (e.g. drugs) to health delivery. It is expected that better financing of healthcare services will have a positive impact on health outcomes, that is, mortality and morbidity rates. However, given the scarcity of resources, focus should also be on improving effectiveness of the little resources coming from the government and households.

Although the total government health expenditure increased from USD6.52 per capita in 2003/04 to about USD$13 in 2010/11, the Ministry of Health's total expenditure, both as a percentage of total government expenditure (6%) and as a percentage of gross domestic product (2%) has been very low (MoH, 2012). The government's health allocation, at an average of 6 percent of the total budget, also falls short of the Abuja Declaration[14], in which Kenya and other African governments pledged to allocate 15 percent of their national budgets to healthcare. This low funding forces households to resort to out-of-pocket financing of their healthcare. Many households have avoided government facilities due to inadequate services. The health expenditure and utilization survey of 2007 noted that the main reason for avoiding the nearest provider is unavailability of drugs (MoH, 2009a).

Essential drugs and supplies are critical ingredients of a well functioning health service delivery system. Patients perceive healthcare in being the availability of medicines. The low availability is blamed on inadequate resources allocated for purchase of drugs and

[14] In April 2001, heads of states of African Union countries met and pledged to set a target of allocating at least 15 percent of their annual budget to improve the health sector. They also urged donor countries to "fulfil the yet to be met target of 0.7 percent of their Gross National Product (GNP) as Official Development Assistance (ODA) to developing countries".

medical supplies. During the Second National Health Sector Strategic Plan (NHSSPII) period, budgetary allocations for drugs and supplies lagged behind salaries allocation. It accounted for about 30 percent of annual costs of the six major expenditure components as shown in Table 2.5, whereas salaries take up approximately 37 percent.

Table 2.5: Six major health expenditure components (Kshs Million)

Fiscal year	Salaries	Drugs & supplies	Lab tests & other investigations	Beds & meals	Allocated overhead	M&E	Total annual cost
2006/07	27,655	23,361	4,887	6,541	9,075	3,025	74,544
2007/08	30,236	25,367	5,835	6,797	10,235	3,412	81,882
2008/09	33,277	27,317	6,597	7,207	11,160	3,720	89,276
2009/10	37,185	30,797	7,259	7,809	12,457	4,152	99,660

Source: MoH (2005)

The low allocations to drugs and medical supplies affect health outcomes negatively, including burdening the households financially. For instance, the government policy states that medical care for children under-five and expectant mothers is free. However, enough drugs and medical supplies are not available in government facilities. Thus, households would have to look elsewhere for private sector providers of drugs and supplies, whose prices are high and sometimes unaffordable (Hotchkiss *et al*., 1999).

2.2.4 Immunization

Immunization is one of the key inputs to the production of health because of its direct impact on child health outcome indicators like infant, child and under five mortality. Immunization plays a very important role in dealing with preventable diseases. This is because it does not only provide long-term defense over life-long diseases, but also gives confidence to a household that their child's risk to certain diseases has been fully minimized. Mwabu (2009) provides evidence on the complementarity hypothesis that when one risk is removed (by the government through immunization) the household has an incentive to invest in health and reduce other health risks.

Overtime, the immunization coverage has improved in the country. However, the coverage in some regions has differed significantly from others. For instance, as Table 2.6 shows, Nairobi had about 99 percent full immunization coverage in 2011, whereas Rift Valley had the lowest at 71 percent followed by Nyanza at 76 percent. Relating this scenario with under-five mortality rates, the Kenya Demographic and Health Survey (KDHS) 2008/09 reports that Nyanza had the highest mortality rate at 149 per 1,000 live births, whereas Central, with an immunization coverage of 86 percent, had the lowest under-five mortality rate of 51 (KNBS and ICFMacro, 2010).

Table 2.6: Full immunization coverage rate of children under-one year

Province	2007	2008	2009	2010	2011
Nairobi	78	74	83	96	99
Central	85	86	92	96	86
Coast	78	75	71	87	80
Eastern	78	64	80	83	91
North Eastern	81	89	67	57	76
Nyanza	66	75	79	79	76
Rift Valley	70	64	71	70	71
Western	68	66	85	90	84
Total	73	71	78	81	80

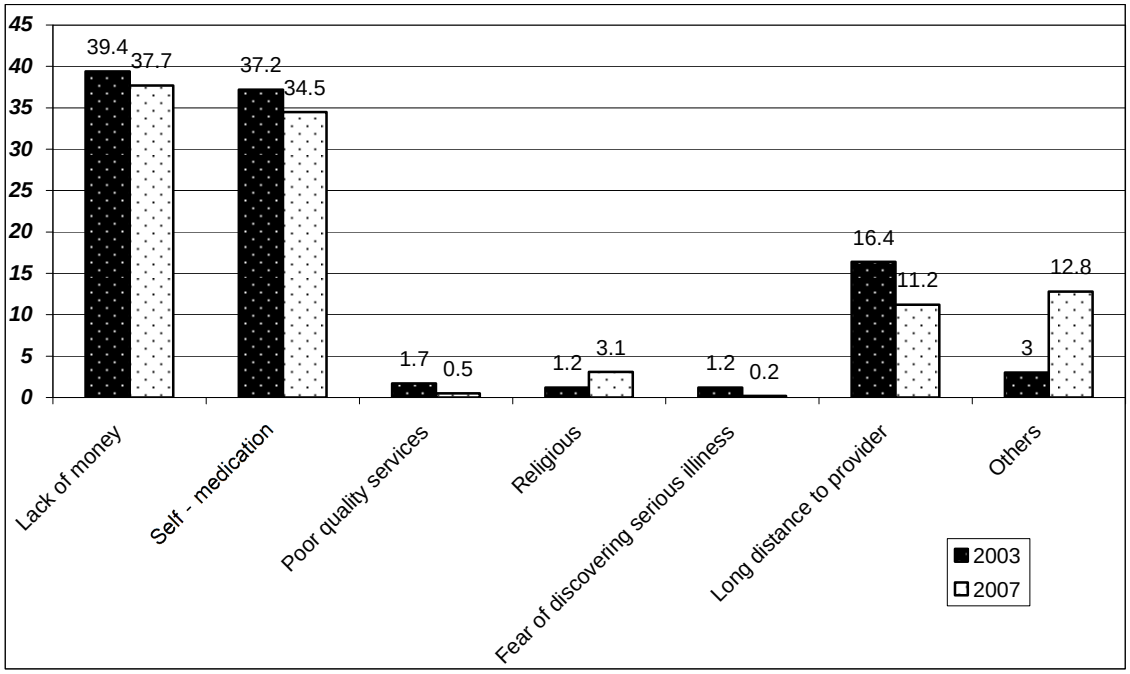
Source: GoK, 2012

From the analysis of distribution of health facilities by region (Table 2.2), Rift valley, Central and Eastern provinces had the leading numbers of health institutions. Save for the Rift valley, full immunization coverage (FIC) has been over 90 percent at one time or the other in Central and Eastern, and the mortality levels in these regions have been impressive relative to other regions. This shows that there could be some correlation between health facilities (inputs) and mortality levels (health outcomes). Also, there could be some other underlying factors that hinder regions like Rift Valley from exploiting the available health resources. Some of these factors have been identified in the past health expenditure and utilization surveys and led to heterogeneous outcomes.

From the 2003 and 2007 health expenditure and utilization surveys, households identified several factors that hinder their access to healthcare. Almost at the same proportion in the two periods, these factors included lack of money, followed by practice of self

medication, and the long distance to the nearest provider as shown in Figure 2.2 (MoH, 2003 and 2009a). Self medication is preferred by many because they cannot afford the consultation fees[15] charged in many health facilities including the cost sharing fees. Other reasons for not visiting health facilities and impact on health indicators include religious and cultural reasons. This should not be ignored in any health policy because they may render whatever amount invested in health irrelevant. For instance, the government may procure vaccines for immunization but a household refuses to immunize their child because of religious inclinations.

Figure 2.2: Reasons for not seeking medical care



Data Source: MoH, 2003 and 2009a.

[15] This may be as a result of scarcity of health professional in some localities.

2.3 Indicators of Health Outcomes

The health of a country can be measured using a number of indicators including life expectancy, infant mortality, and under five mortality. The argument has been that these indicators provide a good reflection of the status of health provision in a country. In addition, the indicators are considered a reflection of the level of development of a country's health system. Kimalu *et al*. (2004) note that infant mortality is affected by both the quality and quantity of healthcare available.

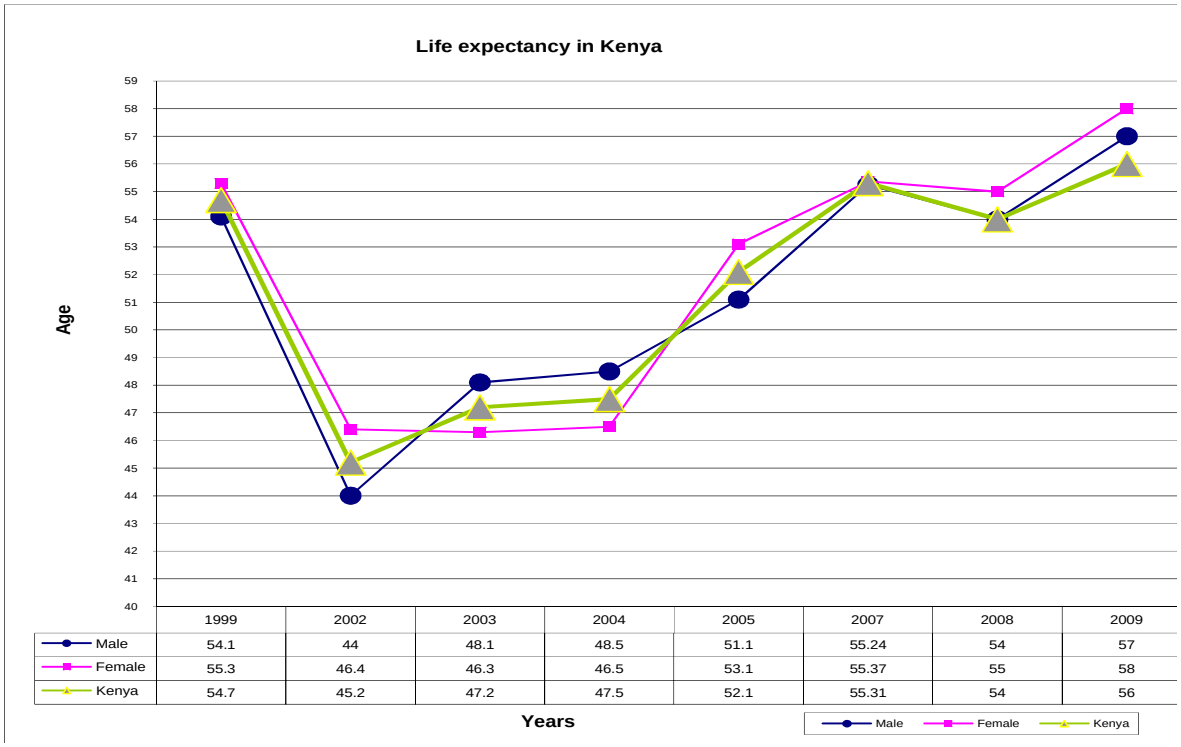
The infant and under-five mortality are considered good indicators of health status because of the assumption that a developed health system first gives priority to the health of the vulnerable, especially children. Hence, if under-five mortality is high, it is likely that the health system is poorly developed. However, underneath these indicators are other key drivers of health status in the nature of health inputs like health facilities, personnel, finance, drugs, and medical supplies. After investing a lot of inputs in the form of health infrastructure, personnel and finance, it is expected that investment will have positive effects on the health indicators.

2.3.1 Life Expectancy

In Kenya, life expectancy numbers have not been consistent since independence. It is expected to be increasing as the country advances in economic development. This was the case since independence up to the mid 1980s. For instance, the Kenya census reports show that by early 1980s, life expectancy at birth was above 60 years in Kenya, reaching 62 years by 1984. However, by the year 2000, it had declined to below 50 years and only

started rising to above 50 years in 2005 (Figure 2.3). It is now slightly above 55 years (GoK, 2001 and 2010a).

Figure 2.3: Life expectancy at birth in Kenya



	1999	2002	2003	2004	2005	2007	2008	2009
Male	54.1	44	48.1	48.5	51.1	55.24	54	57
Female	55.3	46.4	46.3	46.5	53.1	55.37	55	58
Kenya	54.7	45.2	47.2	47.5	52.1	55.31	54	56

Data sources: Kenya Human Development Reports, various

The decline in life expectancy before the year 2002 has been attributed to emergence of diseases like HIV/AIDS[16], malaria, and tuberculosis (TB) among others. For instance, after the discovery of HIV/AIDS in Kenya in 1984, its prevalence started rising from about three percent in 1989 to 13.4 percent in 2000. At the same time, life expectancy declined from a high of 62 years in 1984, to a low of 45 years in 2002. This shows that the health system encountered a shock that it could not deal with successfully. However,

[16] Human Immunodeficiency Virus and Acquired Immune Deficiency Syndrome

since 2002, life expectancy has started to rise as the fight against HIV/AIDS, TB and Malaria has been taken a notch higher. Antiretroviral (ARVs) have become readily available, and malaria and TB treatments have been highly subsidized by the government.

Life expectancy has been higher for women than men in the recent past. Some regions have higher life expectancy than others. For instance, Central province has a life expectancy averaging 64.2 years, with females reaching 68 years as of 2009, while Nyanza province has the lowest at 44.8 years with males at 41.7 years (UNDP, 2010b). Whether this is correlated to the amount of resources that are invested in these areas is a research issue. However, we know that Nyanza province has 11 percent of the health facilities compared to 18 percent found in Central province; immunization of below 80 percent for Nyanza and above 80 percent for Central; but above all, HIV prevalence has been consistently high in Nyanza.

2.3.2 Childhood Mortality

A look at other child health outcome indicators like neonatal, infant and under-five mortality rates indicates that in the last decade (2000-2010), there has been an improvement. The infant and under five mortality rates have improved from highs of 73 and 116 per 1,000 live births in 2,000 to 52 and 74 respectively, in the year 2011 (Table 2.7; 2.8 and Appendix Table A2). The decline has been attributed to improvement in preventive healthcare whereby on average, full immunization coverage (FIC) reached 80 percent in 2011 (Table 2.6). In some regions like Central Province, the FIC is on average

about 90 percent whereas in other provinces like Western and Nyanza, the rate is on average 58 percent and 65 percent respectively, for that decade (Appendix Table A3).

Table 2.7: Performance of health status indicators 2008/09-2010/11

Indicators	**Base year (2007)**	**Actual 2008/09**	**Actual 2009/10**	**Actual 2010/11**	**Target 2010/11**
Under 5 mortality	92	74	74	74	45
Maternal mortality	414	488	488	488	200
Immunization coverage	71	77	77	77	90
HIV prevalence	7.4	6.4	6.4	6.4	6.4

Source: MoH (2012).

From Table 2.8, all the measures of childhood mortality registered an improvement between the year 2003 and 2008/09. For instance, while the neonatal reduced minimally from 33 in 2003 to 31 in 2008/9 according to the data from KDHS, under-five mortality reduced drastically by almost half during the same period. This raises curiosity as to whether the two health outcome indicators are driven by the same or different factors.

Table 2.8: Childhood mortality

	KDHS 2003	**KDHS 2008-09**
Neonatal	33	31
Post-neonatal	44	21
Infant	77	52
Child	41	23
Under-five	115	74

Source: MoH (2010b)

During the same period, there was an increase in budgetary allocations, immunization coverage, and an increase in health facilities, especially associated with funding from the Constituency Development Fund. However, the correlation between the increased investments in healthcare and the improvement in child health outcomes in Kenya is yet to be introduced into government health statistics.

CHAPTER THREE: THEORETICAL AND EMPIRICAL LITERATURE

3.1 Theoretical Literature

This study is informed by the human capital theory pioneered by Schultz (1961), Becker, (1962) and Grossman (1972) and discussed further in subsequent studies by Rosenzweig and Schultz (1983), Nixon and Ulman (2006), Mackenbach *et al.* (2007) and Mwabu (2007). The human capital theory at the level of the individual regards health as a commodity which the individual will wish to consume and maximize subject to his/her budget constraint, given a number of endogenous and exogenous variables or characteristics, which have an impact on an individual's health.

In this case, health is a commodity produced using various inputs. Various studies like Nixon and Ulman (2006), and Thorton and Rice (2008), analyze health status through the production function, where health is an output of a healthcare system, which is produced through inputs to that system. In this case, health expenditures that proxy medical care, constitute health inputs, whose outputs from the health system are the resultant health outcomes measured through life expectancy and childhood mortality. This analysis takes the macro focus where health is viewed as an 'output' say of a healthcare system, which is influenced by the 'inputs' to that system.

Another human capital model adopted in various studies includes the 'investment model of demand for health', which deals with a theoretical and empirical investigation of the demand for the commodity 'good health' (Nixon and Ulman, 2006). This model regards health as a capital good that is inherited and depreciates or deteriorates over time.

According to this theory, investment in health is a process in which medical care is combined with other relevant factors to produce new health, which in part, offsets the process of deterioration in health stock. If the new health is not produced, the health stock tends to zero, and finally results to death.

The above models of human capital are however not different in the sense that the variables employed in their approaches are the same. The approaches are also of the production functions category. The fundamental difference, however, comes in when the analysis is at the macro and micro level (Nixon and Ulman, 2006). For instance, empirical studies show that health is a luxury good at the macro level, whereas studies at the micro level show that it is a necessary good.

As per the human capital theory put forward by Grossman (1972), an increase in health of a community is an asset. The productivity of households living in such a community increases. Increased productivity may lead to more income. More income may lead to increases in wealth. This can eventually lead to poverty reduction, especially if the production structure in such a community is pro-poor. However, if the prevailing conditions are such that the level of inequality is high, the returns to production will depend on who holds more productive assets, hence more wealth. Normally, the poor are deprived of productive assets. Hence, the return to increased production in a given community is biased towards the non-poor.

Investments in human capital are derived from expenditures in health and education and the wealth accumulated by households and communities over time. Health is a capital good, which enables individuals to engage in labour market and hence contribute to production of goods and services. Good health increases the chances of people to work

more hours and hence increase labor supply. In terms of education, health may be positively related to the level of educational attainment. Thus, healthy children are expected to demonstrate less school absence and school drop-out. Healthy individuals are also inclined to have more savings than individuals in poor health. Savings will eventually increase investment opportunities and hence have future influences on income and wealth.

Several studies have also noted the utility derived from health (Rosenzweig and Schultz, 1983; Ajakaye and Mwabu, 2007; Mwabu, 2007; and Mackenbach *et al*., 2007). Most of the studies note that as a consumption and a capital good, health directly contributes to an individual's utility and also goes into the human capital formation. This has been reflected well by parents' human capital investments to their children in the expectation of deriving future utility through their children's support in old age. Utility comes from the fact that good health status is enjoyable and enables individuals to enjoy work and leisure activities. Their productivity is expected to be high because they would experience fewer sickness absences and devote more energy to work. As Mackenbach *et al*. (2007) notes, ill-health negatively affects labor supply. And permanent illness has a larger effect on the number of hours worked than temporary illness, with the effect being larger for men than for women.

Health has also been identified as a key determining factor in utilization of healthcare. Healthcare is an investment in health, hence better access to adequate healthcare is associated with better health and higher levels of healthcare use (Mackenbach *et al*., 2007).

Therefore, this study appreciates the theoretical arguments put forward in relation to production and investments in health. The problem at hand of determining the impact of health expenditure on health outcomes however, fits well with the human capital theory, because households would wish to consume all the health available but they face budgetary constraints. Hence, it is expected that the effect of the budget constraint is reflected in the health outcomes, measured through childhood mortality.

3.2 Empirical Literature

The debate on the impact of public spending and outcomes keeps on attracting attention in policy circles. This is more so for social spending, which on one hand, there are arguments for its positive impact on the economy, whereas on the other side of the research divide, there are arguments that it has no impact on growth or even health. Different authors (e.g. Mackenbach *et al*., 2007; Nolte and Mckee, 2004; Cremieux *et al*., 1999) have used different measures of health outcome as they estimate the effect of health expenditure on health outcomes. Most studies (e.g. Oleche, 2011; Martin *et al.* 2008 and 2007) have used one or a combination of indicators as a proxy for health outcome, which include life expectancy, infant mortality and/or under five mortality rates.

Research studies on the area of healthcare expenditure and health outcomes use infant mortality rates and/or life expectancy at birth as dependent variables (Oleche, 2011; Nixon and Ulman, 2006; Cremieux *et al*., 1999). However, other studies (see Nixon and Ulman, 2006) have used health expenditure as dependent variables because they had different issues to be investigated. This includes health expenditure as a share of gross domestic product (GDP) or per capita health expenditure. In terms of explanatory

variables, Nixon and Ulman (2006) document that income and health expenditure has been used in past studies, although the correlation between the two variables is sometimes high. Other explanatory variables include healthcare variables (such as physicians, nurses, beds, etc); dietary consumption variables (such as alcohol consumption, tobacco, and fat intake); demographic and economic variables. Other variables considered include decentralisation coefficient, political rights, and proportion of workers in formal employment (Subramanian and Canning, 2009).

Nixon and Ulman (2006) review studies that have shown health expenditure as a significant explanatory variable for at least one health outcome in about 12 of 16 studies that were examined. Other studies in the literature found income as a significant explanatory variable (ibid). In some studies, 'decentralization coefficient' posted significant results showing that fiscal decentralisation leads to a decrease in infant mortality rate. Many studies have found Pharmaceutical expenditure to be significantly and positively associated with both child and adult health outcomes.

Mackenbach *et al*. (2007) carried a study in the European Union (EU) to explore the economic implications of health inequalities. The study covered the economic impact of socioeconomic inequalities in health and its measurement, including how large the socioeconomic inequalities are in the EU. The methodology followed in Mackenbach *et al*. (2007) is one that has been developed in epidemiology that estimates the burden of ill-health. It is based on the Population Attributable Risk (PAR) concept, which compares the current situation to a hypothetical situation that everyone should have. For instance, in Mackenbach's study, the PAR approach was used to assess the burden of ill-health that

is attributable to the fact that about half of the population has (the poorer health status corresponding to) a lower socio-economic status than the upper half of the population.

In a similar work, Subramanian and Canning (2009) used data from a National Family Health Survey carried out in India. It contained information on individual characteristics and mortality. The explanatory variables for their study were at three levels: individual, household and state. The variables of interest used by the study in the individual's category were age and sex. For household, asset index quintile, religious affiliation, residence (urban, rural), and access to safe water and sanitation (divided into piped, well, other sources and whether private or public). State data included government spending on medical expenses and public health. Out-of-pocket expenses were also included as a state level explanatory variable.

Subramanian and Canning (2009) used multilevel probit to estimate the effects of health spending at state level, on the probability of death at the individual level. They argue that the multilevel probit model is advantageous because it simultaneously considers the household and individual-level predictors, while allowing for non-independence of observations within groups.

From Subramanian and Canning (2009) study, the variable of interest is a binary response (dead or not) for an individual *i* in cluster *j*.

Therefore, assuming the binary response, y^{ij} is Bernoulli distributed with probabilities π_{ij}: $y^{ij} \sim$ Bernoulli $(1, \pi_{ij})$. If $\pi_{ij} = P(y^{ij} = 1)$ denotes the probability the i^{th} individual is dead, the probit model is represented as:

$$\Phi^{-1}(\pi_{ij}) = \alpha_o + \sum_k (\beta_k \chi_{ijk}) + \sum_l (\gamma_l \, z_{jl}) + \sum (\tau_{kl} \chi_{ijk} \, z_{jl}) + u_{0jk} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (3.1)$$

Where $\Phi^{-1}(\pi_{ij})$ is the inverse cumulative distribution function of the standard normal and *i* and *j* refer to the individual and cluster, respectively;

α_o = the probability of death for the reference group;

π_{ij} = probability that the individual *i* in cluster *j* is dead;

β_k = the coefficient of the k^{th} individual explanatory variable;

χ_{ijk} = the k^{th} individual/household-level covariate;

γ_l = the coefficient of the l^{th} state explanatory variable;

Z_{ijk} = the l^{th} state-level covariate;

τ_{kl} = the coefficient of the cross-level interaction terms;

u_{0jk} = the error term;

Equation 3.1 is estimated in Subramanian and Canning (2009) using the probit maximum likelihood estimator (MLE). However, their study uses a two-stage probit regression to control for endogeneity of public spending, whereby, in the first stage, they look for an instrument as is conventional and in the second stage, they use the predicted value of the health spending. Their study found that an increase in public health spending decreases the probability of death, especially for the young and the elderly. In addition, other factors like household poverty status, location of residence (rural/urban) and access to toilets facilities affect mortality.

Studies by Nolte and Mckee (2004) and Cremieux (1999) noted that lower healthcare spending was associated with an increase in infant mortality (poor child health) and a decline in life expectancy, and the relationship was independent of a number of (socio)

economic and lifestyle variables. The study documents some findings that estimated that a 10 percent reduction in healthcare spending was associated with higher infant mortality of about 0.5 percent and lower life expectancy of 6 months in men and 3 months in women.

After estimating three models of the relationship between health expenditure and outcomes, Nixon and Ulman (2006) found that health expenditure, the number of physicians and nutrition, have a positive relationship with health outcome, hence are significant determinants of male life expectancy. On the other hand, pollution is significant but has a negative effect on health outcome and hence male life expectancy.

One of the main findings in the Nixon and Ulman (2006) analysis is that with the exception of infant mortality, the predominant determinants of both male and female life expectancy are the unaccountable salient variables and country-specific characteristics contained in the constant term. Thus, Nixon and Ulman (2006) conclude that healthcare expenditure made a relatively marginal contribution to the improvements in life expectancy in the EU countries over the period of analysis.

Martin *et al*. (2008; 2007), in studies on the link between healthcare spending and health outcome in England found that this link exists. They analyzed the extent to which additional healthcare expenditure yields patient benefits in the form of improved health outcomes. For instance, they found a strong positive link between expenditure and lower mortality rate and especially expenditure on certain categories of diseases. Their analysis also concluded that regions with high health needs and poor health outcomes tend to attract high levels of healthcare spending.

Mackenbach *et al*. (2007) note that in the European countries, substantial inequalities in health within population existed at the start of the 21st century. People with low level of education, low occupational class, or low levels of income tend to die younger and had a high prevalence of diseases. Hence, if all persons would have the corresponding high educational levels, it would decrease the number of General Practitioner's (GP) and specialist visits by 16 percent in EU, and the number of nights in hospital by 22 percent in all persons aged 16 years and older. The study therefore concluded that mortality levels are higher among those in less advantaged socio-economic conditions, regardless of whether socio-economic position is measured by education level, occupational class, or income level.

Mackenbach *et al*. (2007) continues to show that inequalities in mortality (and hence health inequalities) exist among women as they do in men. They noted that most studies on health inequalities (as measured through mortality), have mainly focused on adults particularly middle aged men and women. However, there are inequalities in other ages as well, that is, for the young and elderly. Therefore, starting with young adults (30-39 years old), relative health inequalities[17] decrease gradually with age but absolute inequalities[18] increase consistently with advancing age, and reach their highest values among the old (+90). As a result of the differences in the risk of dying as observed at various ages, those from lower socio-economic groups tend to live considerably shorter lives than those with more advantaged positions. This seems to be confirmed by a UK report on health inequalities, which found that people from high socio-economic classes

[17] Relative means rate ratios comparing a lower and a higher socio-economic group.
[18] Absolute means rate differences comparing a lower and a higher socio-economic group.

(for instance) who smoke, live longer than those from lower socio-economic classes who smoke (House of Commons, 2009).

Mackenbach *et al*. (2007) found an association between lower earnings and poor health. The study notes that people with "very poor" health were about two times less likely to participate in the labor force than those with "very good" health. Also, persons with "very good" or "good" health had about four times higher earnings than those with "poor" and "very poor" health. The difference is also caused by the number of hours worked among the economically active persons. Regions with more population in the lower socio-economic group will generally have lower output than regions concentrated with population in higher socio-economic group. Hence, the endowed assets are likely to influence health outcomes in these regions.

Government investment in health promotes government savings. A study by Mackenbach *et al*. (2007) found that there is a direct association (and hence reduction) in unemployment and disability benefit, when there are improvements in health resulting from higher public expenditure in the health sector. The study found that there was an association between poor health and receipt of unemployment benefits. People with "very poor" health on average receive about 20 times more disability benefits than those with "very good" health.

Generally, Mackenbach *et al*. (2007) note that health inequalities are largely due to the unequal distribution of health determinants between people with different positions at the social hierarchy. Their study notes that people in the lower socio-economic positions are more likely to adhere to unhealthy behaviors such as smoking, inadequate diet, excessive alcohol consumption, and lack of physical exercise. Thus, they more often suffer from

disease and disability. Mwabu (2007) documents evidence from literature that shows that positive behavioural changes (e.g. quitting smoking or overcoming addiction to alcohol) is associated with better health, just like the use of medical care.

It is also rightly observed that poor health was consistently related to visits to doctors and health facilities. Mackenbach *et al*. (2007) found that people with "very poor" health had more than 6 times more GPs visits and more than 9 times more specialist visits than those with "very good" health. However, in Canada, Cremieux *et al*. (1999) found that higher income groups have a higher consumption of specialist services, despite their better health than lower income groups. Their better health could be associated to the fact that they have better access to specialist services. The lower income group uses more of physician consultations than specialist services. This is the same case as in Netherlands, where the use of family physician services is 84 percent higher among lower income groups (Mackenbach *et al*., 2007).

Nixon and Ulman (2006) used a production function and defined two models on health expenditure and health outcomes, with life expectancy and infant mortality as proxies for health outcome. They run econometric analysis on a fixed effects model conducted on a panel data of 15 European Union countries over the period 1980-1995. The general finding from their study was that increases in healthcare expenditure led to significant improvements in infant mortality, but marginally to life expectancy.

For the model of life expectancy, they found that health expenditure and number of physicians has a positive and significant relationship with health outcome. In terms of gender, the two variables were significant determinants of female life expectancy. When Nixon and Ulman (2006) estimated the infant mortality model, they found that health

expenditure and number of physicians were the only significant determinants in the reduction of infant mortality for the different EU countries. From Canadian data, Cremieux *et al*. (1999) was able to show that lower healthcare spending is associated with a statistically significant increase in infant mortality and a decrease in life expectancy in Canada.

Okurut (2009) carried out a study on the determinants of birth weight in Botswana, in the general context of demand for reproductive healthcare. The study employed an instrumental variable (two-stage least squares -2SLS) model and a utility maximization framework, which this study is borrowing from (see Mwabu, 2009). This study presents the demand for reproductive healthcare in a utility framework, where the utility maximization behavior of the mother is defined as:

$$U = U(X, Y, H) \quad \text{3.2}$$

Where

U = Utility derived from consumption of goods, including reproductive health;

X = Health neutral goods that only yield utility to a mother but have no direct effect on reproductive health status of the mother;

Y =Health related goods or behavior that yields utility to the mother and also affects birth weight;

H = Reproductive health status of the child, measured by birth weight.

Okurut (2009:8) estimates the following structural equation, which defines the birth weight production function.

$$B = w_1\delta_b + \beta M + \varepsilon \quad \text{.....3.3}$$

Where

B, *M*, is birth weight, and immunization status of the mother respectively;

w_1 = a vector of exogenous variables;

δ, β, *and* ε = vectors of parameters to be estimated, and a disturbance term, respectively.

The study found that socio-economic characteristics of a household positively and significantly influence the birth weight of a child. This includes the positive and significant effect of mother's and husband's level of education on birth weight. This is associated with the fact that educated mothers have better information that influences their behavior towards nutrition and pre-natal and antenatal care, and the educated husbands are better informed on the advantages of their wives utilizing reproductive health services. Mwabu (2009) similarly found that the health input of the mother contributes to child health (measured in birth weight).

In Kenya, Kiringai (2006) documents a number of studies (e.g. Gupta, Clements and Tiongson, 1998) that have looked at the relationship between public spending and outcomes. This includes the impact of public spending on outcomes like health status and education attainment. As noted by Kiringai, there are arguments that public provision of services could lead to 'crowding out' of private investment and provision. Hence, the marginal effect of public expenditure becomes negligible. It could also be the case that public spending could be ineffective due to among other things leakages and weak institutional capacity (ibid).

Government expenditure has however been considered as an enhancer to private sector activities. Therefore, government spending is said to improve private sector's capital and labor. For instance, public spending affects labor productivity through knowledge accumulation and healthcare (Kiringai, 2006). Kiringai notes rightly that public spending can affect the volume of labor supplied through its impact on the state of health. Public expenditure on the healthcare system is expected to reduce illness and absenteeism, and hence increase the quantity and quality of labor.

A study in Kenya by Maina (2006) examined the inequalities in financing and delivery of healthcare and the extent to which the poor benefited from public spending. The study used the Benefit Incidence Analysis (BIA) tool, which measures the net unit costs of providing any service. The tool basically measures who gains from public spending and is given by the following formula.

$$\text{BIA} = \frac{(\text{Annual total costs of public provision of service}) - (\text{proceeds from user fees})}{\text{Annual number of units of the services provided}}$$

The study analyzed the public health spending as well as the out-of-pocket spending. Maina (2006) established that the poor suffer from higher morbidity and mortality rates; however, they are less likely to seek medical care when ill due to the high cost of care. The study also found that in Kenya, there is poor targeting of public spending on curative care. Hence, the study focused on the provision of healthcare services to the poor and recommended the need for reallocation of health resources towards services used primarily by them.

An analysis by World Bank (2009) on poverty and inequality assessment in Kenya also focused on health spending from the perspective of poverty and inequality. The study used data from the 2005/2006 Kenya Integrated Household and Budget Survey (KIHBS) alongside fiscal data. Using the BIA tool, the study calculated the unit costs in government health facilities by making use of shadow health budget. Like Maina (2006), the World Bank study looked at the distribution of benefit incidence by quintile. The findings of the two studies were almost similar: poor people gain little directly from the significant spending on the highest level of healthcare delivery, since they hardly use referral hospitals. Also, the poorest 40 percent of the population gain 40 percent of the primary subsidy.

Oleche (2011) estimated the effect of out of pocket health expenditure on mortality level in Kenya. The study used the household expenditure and utilization survey data of 2007. The study estimated a linear probability equation and a probit model of child health. The major findings of the study were that a percentage increase in out of pocket expenditure in health is associated with a decrease in mortality level by 0.16 percent. Also, a full subsidy on user charges per visit or on the health inputs used to produce health services decreases mortality level by 0.51 percent.

3.3 Overview of the Literature

Different authors have used different measures of health outcome as they estimate the effect of government health expenditure on health outcomes. Most studies have used one

or a combination of indicators as a measure of health outcome, which includes life expectancy, infant mortality and/or under five mortality rates.

Nixon and Ulman (2006) show that majority of studies on the area of healthcare expenditure and health outcomes use infant mortality rates and/or life expectancy at birth as dependent variables. However, other studies have used health expenditure as dependent variable. This includes health expenditure as a share of GDP or per capita health expenditure. Explanatory variables used include healthcare variables (such as physicians, nurses, beds, etc); dietary consumption variables (such as alcohol consumption, tobacco, and fat intake); demographic and economic variables.

Whereas Nixon and Ulman (2006) used a production function framework in their study, their analysis was at the macro level and covered 15 European countries. This study is a micro level study based in Kenya and uses household data set. It considers neonatal, infant, and under-five mortality as a measure of child health outcome unlike in Nixon and Ulman (2006), whose proxies are infant mortality and life expectancy. Their study also recommends further research in exploring the causal link between health outcome and health expenditure, because of conflicting results and methodological issues that need to be addressed.

Findings from Nixon and Ulman (2006) show that healthcare expenditure made a relatively marginal contribution to the improvements in life expectancy in the EU countries over the period of analysis. They however failed to consider that household expenditure on health, directly or indirectly, contributes a synergy to government expenditure in health, as we hypothesize. Hence, their study did not consider the interaction effect of household and government investments in health. Nixon and Ulman

(2006) conducted their study in EU countries which are more developed, and the results can differ significantly with findings of a study based in a low income country.

Mackenbach *et al*. (2007) focused more on health inequalities in the EU, especially comparing those from lower socio-economic status and those from higher economic status. They used personal income and assets as the measure of economic impact on health outcome. However, they failed to estimate what proportion of the income or assets was going to health. Their study was also macro based.

Okurut (2009) and Mwabu (2009) are among the few child health studies carried out in Africa but on the determinants of birth weight in Botswana and Kenya respectively. Whereas the studies found that characteristics of the mother have an impact on child health (proxied by child weight), they failed to connect that the positive effect of immunization is because of government expenditure together with the household playing their role by agreeing the uptake of immunization. Okurut (2009) employed an instrumental variable (2SLS) model and a utility maximization framework, which this study is borrowing. However, we employ the control function approach to investigate the impact of household and government health expenditure on child health outcomes.

In Kenya, Kiringai (2006) looked at the impact of public spending on outcomes like health status and education attainment. The study's focus was macro and on public spending in general, whereas this study's focus is health spending at the household level. Other studies on public spending in health include Maina (2006) and World Bank (2009), who estimated the benefit incidence from public spending on health. These Kenyan studies did not attempt to establish the health outcomes from the government investments. The focus was also on the poor though we know that health has a

characteristic of a public good in the sense that an outbreak (say polio) can have devastating impacts, whether it is from a poor or a non-poor household. This study examines the impact of the government resource allocation on health outcomes of all households (whether poor or non-poor). It also estimates econometrically, the impact of health inputs on health outcomes, whereas Maina (2006) and World Bank (2009) used BIA approach.

Oleche (2011) considered out of pocket expenditure as the major health input into child health. This study failed to recognize the complementarity effect of household health expenditure (HHE) and government health expenditure (GHE), yet HHE and GHE alone may have no or limited impact on health outcomes. Also, whereas Oleche (2011) makes use of a structural Linear Probability Model (LPM), this study in addition employs the control function approach (CFA) to control for both endogeneity and heterogeneity biases.

As already emphasized severally, this study is about the effect of health inputs on child health outcomes. Using KIHBS, the dependent variable is mortality at the household level but the treatment variables (household and government health expenditures) are both at the household and county levels. Whereas Oleche (2011) has assets and income (land acreage) as the main control variables, the study fails to recognize the role of government investments in health.

Whereas many of the reviewed studies show substantial work has been done in estimating the impact of household and government expenditures on health outcomes, none has analyzed the joint effect of both expenditures. Some of the previous studies in this area focus on government expenditure, some on household expenditure, but none has

tried the interaction of the two to try and establish whether there is complementarity between household and government health expenditures in reducing child mortality.

Many studies have taken the macro level approach, where we know health is taken as a luxury good (Nixon and Ulman, 2006); this study's focus is the micro level, where household level analysis shows that health is a necessity (Costa-Font et al, 2009). In Kenya, there are those studies that have estimated the benefit incidence from public spending on health, but without looking at the impact on health outcomes. Others have studied mortality determinants, ignoring the fact that the risk of death of a child declines with age, and is influenced by the social and economic status of the mother.

This study makes a contribution by filling these information gaps in the above research areas using household data, enriched with county-level data. The study also establishes for the first time in Kenya the complementarity between household and government health expenditures in the promotion of child health.

CHAPTER FOUR: ANALYTICAL FRAMEWORK AND METHODOLOGY

4.1 Analytical Model

The analytical framework for this study is based on the household health production model developed by Rosenzweig and Schultz (1983). According to this framework, there is a direct, structural relationship between the use of an input such as medical care and the health of an individual. However, the utilization of that input is constrained by its access due to among other things, price, availability, and household socio-economic and demographic characteristics.

We know from Grossman (1972), Rosenzweig and Schultz (1983), and Mwabu (2007), that health is partly produced through consumption of health inputs, which could be marketed or non-marketed. Investments in health capital are produced by households through a health production technology that combines time, medical care, food, physical exercises, housing and recreation, among other inputs. That is, individuals use these inputs to produce health. Therefore, when households and the government set aside health funds, it is to provide medical care that contributes to investments in health. Hence, both household and government health expenditures become part of the health inputs.

In modeling the demand for health inputs, this study follows Grossman (1972), and Rosenzweig and Schultz (1983) household health production frameworks. This framework has also been used by Ajakaye and Mwabu (2007) and Mwabu (2007; 2009).

Grossman (1972) notes that the level of health is determined by the level of resources allocated to its production. It is therefore not exogenously produced. When these resources are consumed as part of health inputs, individuals derive utility from the resultant health. The demand for health by an individual is therefore analyzed through the utility maximization framework that includes both the consumption and investment aspects of health inputs.

This section borrows heavily from the works of Rosenzweig and Schultz (1983:725), Mwabu (2007:8; 2009) and Okurut (2009:6) to describe the analytical model. Thus, as described in these studies, a household's preference orderings over health, health-related and health neutral goods can be characterized by a utility function of the form:

$$U = U(X, Y, H) \quad (4.1)$$

Where

U = Utility derived from consumption of goods, including health;

X = Health neutral goods that only yield utility to an individual but have no direct effect on the health status of the individual e.g. clothing;

Y =Health inputs or behavior that yield utility to the individual and also affects health status positively (e.g. physical exercises) or negatively (e.g. smoking); and,

H = Health status of the individual.

It has been shown that investments in health depend on the extent of an individual's health status, which is a function of observable and unobservable factors. Therefore, health is described as:

$$H = H(Y, Z, \mu) \quad (4.2)$$

Where:

Y = as defined above;

Z = health inputs like medical care that have a direct effect on health status; and,

μ = the component of health status that depends on unobservable characteristics of an individual that influence their health status (e.g. genes or environmental conditions).

For an individual to maximize utility as given in equation 4.1, he/she will face a budget constraint of the form:

$$F = XP_x + YP_y + ZP_z \quad \ldots\ldots (4.3)$$

Where

F = money income; and,

P_x, P_y, and P_z are prices of health neutral good X; health related consumer good Y, and health inputs Z, respectively.

Following Rosenzweig and Schultz (1983:726) and Mwabu (2007:9) and borrowing their notation, the budget constraint for the household in general terms for *r* purchased goods can be written as:

$$F = \sum_t Z_t P_t \quad t = 1, \ldots, r \ldots\ldots (4.4)$$

where, goods X, and Y in equation 4.3 have been collapsed into Z

Similarly, the demand function for health[19], which the household must produce, may be expressed as:

$$H = \psi (P, F, \mu) \quad \ldots\ldots (4.5)$$

Where in equation 4.4 and 4.5, F is the money income, p_t are the prices of goods (e.g. P_x, P_y, P_z), and Z_t is a vector of all purchased goods (i.e. all the subsets of X, Y, and Z) that are obtained from the market.

On maximizing equation (4.1) subject to the health production function (4.2) and budget constraint (4.3), the household's reduced-form demands for goods X, Y, and Z is expressed in the following form as expressed in Okurut (2009:7).

$$X = D_x (P_x, P_y, P_z, F, \mu) \quad \ldots\ldots (4.6)$$

$$Y = D_y (P_x, P_y, P_z, F, \mu) \quad \ldots\ldots (4.7)$$

$$Z = D_z (P_x, P_y, P_z, F, \mu) \quad \ldots\ldots (4.8)$$

Following the approach in Mwabu (2007:10) and Rosenzweig and Schultz (1983:726), solving equations 4.2, 4.4, and 4.5 simultaneously yields a hybrid health production function, which links health inputs and health status. The hybrid model is of the following form:

$$H = \theta (Y_m, Pl, F, \mu), l=1, \ldots, m\text{-}1, m+1, \ldots, r. \quad \ldots\ldots (4.9)$$

[19] Equation 4.5 is both a health demand function and a health production function (Meta production function). It is a Meta production function because health status is given as a function of prices.

Where *H, F and* μ are as earlier defined; Y_m is medical care, the health input that has a direct effect on health status, denoted earlier as Z; *Pl* is a vector of prices of type *m* health inputs. The health input, Y_m is endogenous because for an individual to invest in healthcare, the initial health condition matters. That is, an individual who is in a critical condition from malaria would spend more than another whose malaria condition is mild. Thus, the health condition one is in determines the amount of money to be spent to restore the health to the optimal level. In this study, Y_m is proxied by private health expenditure. The amount spent on healthcare depends on an individual's current health status. Therefore, Y_m depends on *H,* the initial health status before Y_m is demanded. This implies that the endogeneity of Y_m should be considered during the estimation of equation (4.9).

In the absence of suspected endogeneity, equation (4.2) would be the basic model for estimation of the effect of health inputs on child health status, when Z is interpreted as medical care and *H,* as health status. However, we know from literature (Okurut, 2009; Mwabu, 2007) that in equation (4.2) medical care is endogenous to health status, that is, the amount of medical care consumed by a child would depend on his/her initial health status. For instance, a child who has HIV/AIDS would spend more than a child suffering from worms under normal circumstances. Hence, instruments for medical care are needed in order to have unbiased estimates for its effect on health status. The instruments for medical care are the factors that affect its demand without influencing directly the health status of an individual. Some of these factors include age structure, household assets ownership, enrolment in insurance, and distance to the health facilities, among others. In our study, the age structure variable fitted well as an instrument for medical care, as

proxied by private health expenditure. Hence, this study uses the proportion of those aged 60 years and above as the instrument for $Y_{m.}$

Following Mwabu (2007), Okurut (2009:10) and the related literature, the estimation equation that is used in this study can be summarized as follows:

$$B = w_1\delta_b + \beta_1 M_1 + \beta_2 M_2 + \varepsilon_1 \quad \text{..... (4.10)}$$

$$M = w\delta_m + \varepsilon_2 \quad \text{..... (4.11)}$$

Where

B = health outcome (neonatal, infant, and under-five mortality);

M = medical care (healthcare expenditure);

w_1 = a vector of exogenous variables;

w = exogenous variables consisting of $\boldsymbol{w_1}$ covariates that belong in the health status equation and a vector of instrumental variables, $\boldsymbol{w_2}$, that affect medical care (M) but have no direct influence on health status (B). The instrumental variable considered includes the proportion of the household members aged 60 years and above.

δ, β, and ε = vectors of parameters to be estimated, and a disturbance term, respectively.

Previous studies (Oleche, 2011; Okurut, 2009) have estimated equation 4.10 using the IV approach. However, we know that the endogeneity problem on the household health expenditure is very complex, hence if not properly taken care of, we are likely to get biased results. This is because a household may spend a lot of resources on health

because of a heavy burden of diseases, and since a child is not immunized (due to lack of government allocation on health), the child will be sick for example, with measles. When that is treated, they will fall sick of whooping cough; and within a short time, they might fall sick of malaria. Thus, a household might spend a lot on health because of the high disease burden encountered.

On the other hand, a household with an immunized child may incur lower expenditures on health because such a child is not likely to fall sick from the immunizable diseases. Therefore, the sources of endogeneity of health expenditure have to be controlled properly to get the real impact of health expenditure on health outcome. We therefore use the control function approach, which has been shown (see Mwabu, 2009) to be more effective in controlling endogeneity than the IV or 2SLS methods. Therefore, making use of an instrumental variable approach, we predict residuals for the household health expenditure and incorporate them in equation 4.10.

We also know that a shilling invested by two households will have different health impacts on the two households (Mwabu, 2009). This is because of some particular characteristics associated with each of the household. This introduces heterogeneity in the equation. To take care of this in the estimations, we interact the predicted expenditure residuals with the household health expenditure so that the extended equation 4.10 yields the following estimable equation:

$$B = \alpha_0 + w_1\delta_b + + \beta_1 M_1 + \beta_2 M_2 + \alpha_1 V + \gamma\,(M_1 + V) + \mu \quad \ldots\ldots\ldots\ldots\ldots (4.12)$$

Where

M_1 = private health expenditures;

M_2 = public health expenditures;

V = fitted residuals of M_1;

w_1 = exogenous variables;

μ = a composite error term comprising ε_1 and a predicted part of ε_2; and,

α, δ, β, γ = parameters to be estimated.

When equation 4.12 is exposed to the data, its practical form is denoted as:

$$Mi = \alpha_0 + \beta_0 W + \beta_1 HHE + \beta_2 GHE + \gamma_1 (HHE*GHE) + \gamma_2 (HHE*R\_HHE) + \gamma_3 R\_HHE + u \quad \text{..... 4.13}$$

Where

Mi = child mortality measure (i=neonatal, infant and under-five mortality);

W = control covariates (mother's education, education of head, mother's age, area of residence and gender of household head);

HHE, GHE = are private and public health expenditures, respectively;

R_HHE = fitted residuals of *HHE*, derived from a Linear Probability Model (LPM) of HHE with age structure (proportion of household aged 60 years and above is the exclusion restriction);

u = composite error term comprising ε_1 and a predicted part of ε_2; and,

α, β and γ = parameters to be estimated.

In the model specifications, the dependent variable is a dummy with one representing the presence of a child's death in a household and zero for absence. We run three versions of the equation 4.13, where the first version is an LPM of child mortality measure regressed on all other variables except the predicted residuals, *R_HHE* and the interaction terms from the residual and private expenditure, *HHE*R_HHE* and interaction of private expenditure and public expenditure, *HHE*GHE*. The interaction terms are included in a second model of equation 4.13, which is a control function approach (CFA) model[20].

The CFA enabled us to predict the residuals and include the same in our equations for estimations. This would not have been possible in instrumental variable (IV) or 2SLS approaches (Mwabu, 2009). Therefore, using CFA, we were able to control for endogeneity using predicted residuals and at the same time, we controlled for heterogeneity by interacting the residuals with the endogenous variable, HHE. We also estimate two versions of the CFA models, with one including the mother's level of schooling and another including only the household's head level of schooling. These two variables were correlated because there are some mothers who are heads of households. Hence, we could not include both variables in the same model.

Due to suspected endogeneity of private health expenditure, an (IV) approach was adopted whereby we ran a regression model for private health expenditure on exogenous variables that included the age of the mother, years of schooling of the mother, gender of the household head, area of residence, and proportion of household members aged 60 years and above. The number of household members aged 60 years and above was used as an instrument for private health expenditure. Theoretically, age categories are used as

[20] We also use the F-statistic to check whether the estimated coefficients are jointly significant, especially for the interaction variables.

instruments of health expenditure. The age category of 60 years and above was used because it is exogenous to household health expenditure and it has been found that the category mainly comprises people who are elderly, are vulnerable to diseases, and hence utilize more health services. As Becker (2007) notes, a large proportion of health expenditures are made at older ages when people spend on various medical interventions to avoid dying. On average, adults of over 60 years are part of the population that is dependent on the other economically active population. That is, they are not part of the household's decision-makers, and therefore cannot choose the level of their own health expenditure. Specifically, we test for the conditions set for good instruments viz: (i) must be correlated with the endogenous variable; (ii) must be exogenous; (iii) must not be correlated with the dependent variable except through the endogenous variable[21]. In addition, we tested for weakness of the chosen instruments through the F-test and by testing for the endogeneity of expenditure using the Durbin-Wu- Hausman test. An F-statistic greater than 10 for the excluded instruments implies an instrument is not weak (Cameron and Trivedi, 2005).

There was also a suspected heterogeneity. This is because individuals are likely to have information concerning their genetic health endowments, which causes them to alter their behavior with respect to their use of health inputs (Rosenzweig and Schultz, 1983). Hence, we are not likely to get the real impact of the health input on health outcomes. For instance, a mother may be HIV positive but has not declared it to the doctors. Hence, any child she gives birth to fails to live for long. Such behavior creates a correlation between the use of health inputs and other unobserved behaviors embedded in the structural

[21] The results are documented in Appendix table A4 where F-statistic was 11.96. age60 is highly significant at 1%, which implies it is correlated with household health expenditure. Theoretically, age60 is exogenous to child mortality rates.

residuals. The use of health input may not only affect the health outcome, but may also affect utilization of healthcare. This becomes one source of heterogeneity problem because of the unobservable influences of an individual's behavior on health status.

To correct for heterogeneity, we interacted the predicted residuals with private health expenditure. This ensures that the causes of heterogeneity are arrested in our model, hence their effect on private expenditure is captured during estimation.

From equation 4.13, the impact of the HHE on child health outcome is given by the following partial derivatives:

$$\frac{\partial \text{mi}}{\partial HHE} = \beta_1 + \gamma_1 GHE + \gamma_2 R\_HHE \text{ ……..} \quad 4.13a$$

while that of GHE on child health outcome is given by the partial derivative of 4.13 that is given by:

$$\frac{\partial \text{mi}}{\partial GHE} = \beta_2 + \gamma_1 HHE \text{ ……..} \quad 4.13b$$

Equations 4.13a and 4.13b depict a situation where the impact of private and public health expenditures is determined by not only their impact, but that of the counterpart. This implies that there is complementarity effect from private and public health expenditures. The investment in health by the government provides incentives to the household to adopt a positive healthcare behavior that promotes child health, and hence ensures the reduction of health risks to the children. Therefore, when the government

undertakes immunization, it provides households with an incentive to invest more in preventive healthcare to reduce the risk of the child dying. However, in the absence of say, immunization, households may not invest much into the child's health because even if they don't die of say malaria, they are likely to die of measles due to lack of immunization. Thus, both households and government increase health investments to boost the children's health. Becker (2007) describes well the scenario of complementarities between survivorship rates of different diseases such that an increase in probability of surviving one disease raises the expected benefit from improving the probability of surviving other diseases.

This study argues that whereas independent government or household expenditure is expected to produce positive health outcomes, this can only happen if all other things are held constant. These other things are the unobservables that are in the residuals. This study observes that holding these unobservables constant in terms of health is not practical. These unobservables include: transport costs to the health facility where government is offering free healthcare; correct interpretation of prescriptions; and correct storage (e.g. refrigeration of antibiotics) and use of drugs (e.g. completing and taking a full dosage). Thus, where we expected the government or household expenditure alone to contribute positively to health outcome, the unobservables (which we should have conceptually held constant) cancels the effect out.

Secondly, this study takes government and household health expenditure as complementary goods. That is, both parties have to spend. To an extent, there is a minimum that the household and the government has to spend on health for a child to achieve an optimal health status. For instance, when a government offers free

immunization, the household has to spend a minimum in terms of transport to where the free service is being offered. It can also be the case that the government offers free drugs that have to be taken after food (lest they will not be effective) and hence the household has to spend on food for the drugs to be effective. There is also the need to consider the opportunity cost in healthcare utilization even when there is no money price to its use. The situation of this complementarity in our study is captured in our equation 4.13 by the coefficient $\gamma_{1,}$ from the interaction term HHE*GHE. Equation 4.13 is estimated, and results reported in chapter five.

4.2 Data

This study used data from the Kenya Integrated Household and Budget Survey (KIHBS) of 2005/2006[22] and the government health expenditure data from the Ministries of Health. KIHBS contains information for a total of 13,390 households comprising 8,570 (rural) and 4,820 (urban). The KIHBS has information on household consumption and expenditure items at weekly, monthly, and annual levels. This information was used to approximate household (private) expenditure levels, and subsequently, the proportion of household budget spent on health. KIHBS also contains information on the occurrence of deaths in a household for both children and adults. The neonatal, infant, and under-five mortality has been used as a measure of health outcomes for the household. The mortality rates have been widely used as health indicators because they are associated with economic development and availability of health services. The data also contains

[22] Though this data is for 2005/2006, it is rich in information that can assist in analyzing current policy issues that is facing the country in terms of health financing. For instance, the National Health Accounts of 2009/2010 shows that private and public contribution to health financing was 39.3% and 29.3% in 2005/2006, only to decline marginally to 36.7% and 28.8% in 2009/2010 respectively,

information on demographic characteristics of the households like gender, age, household size, and level of education.

Data on government (public) health expenditure was collected from district allocation budget (DAB) reports from the Ministry of Health. The data covered both recurrent and development expenditures. The Ministry's financial allocations to its district representatives are meant for expenditure in specific line items. This includes purchase of medical drugs, uniforms, general office supplies, maintenance of machines and equipment, among others. For each district, the expenditure on all these items was aggregated. Since the government health expenditure is not individualized, the aggregate figure was allocated to each of the households in a particular district. The reasoning is that government expenditure is more of a public good in nature. For instance, a health facility or laboratory equipment or even a doctor will be available for use by all members of the community, irrespective of being consumed by another community member. The government expenditure data was merged with KIHBS in such a way that all the households in a particular district were assigned the money allocation equal to their district allocation. In particular, this study considered the government expenditure on preventive healthcare under the assumption that curative health expenditure is captured by the household health expenditure.

4.3 Description of Variables

Table 4.1 Definition of the variables for the study

Variable	**Definition**	**Hypothesis**
Neonatal mortality	Number of deaths reported for children under one month (=1 if death, 0 = no death)	Dependent Variable
Infant mortality	Number of deaths reported for children under one year (=1 if death, 0 = no death)	Dependent Variable
Under five mortality	Number of deaths reported for children under five years (=1 if death, 0 = no death)	Dependent Variable
Healthpercent	Annual household expenditure on health as a percentage of total household expenditure	Negative
Yearsch_m	Highest level of education completed by the mother	Negative
Hhyearsch	Highest level of education completed by the household head	Negative
Motherage	Age of the mother	Negative
Motherage2	Age of the mother squared	Negative/positive
Gendehh	Gender of the household head (1=female; 0 = male)	Negative/positive
Lnpreventive	Log of preventive health expenditure by the government	Negative
Rurban	Location of residence (rural=1; urban=0)	Positive
Age60	Proportion of household members aged 60 years and above	Positive
Preventive_hhpct	Interaction between Healthpercent and Lnpreventive	Negative
Healthexpresid	Predicted residuals	?
Healthexpresid2	Predicted residuals squared	?
Healthpct_resid	Interaction of Healthpercent and healthexpresid	?

The null hypothesis on all the explanatory variables is that they have no influence on the dependent variables.

CHAPTER FIVE: EMPIRICAL RESULTS AND DISCUSSION

This chapter presents the results from our analysis. The section starts with reporting selected descriptive statistics, while results from the econometric models follow.

5.0 Descriptive Statistics

Table 5.1 presents the descriptive statistics of the variables used in our estimated models. The unit of analysis was the household and therefore, as per the observations presented, the number of observations differed depending on the variable under consideration. Due to merging of different modules of the KIHBS dataset, some few observations were dropped due to missing information. This however did not affect the quality of the analysis.

Our dependent variables (neonatal, infant and under-five mortality) represented the occurrence of death in a household. These are captured as dummies with '1' indicating the presence of death and '0' absence. The summary statistics are captured through mean, standard deviation, minimum and maximum. Given that our treatment variables are household (private) and government (public) health expenditures, we interpret only the descriptive results of these variables.

Table 5.1: Summary statistics

Variables	Observations	Mean	Std Dev.	Min	Max
Neonatal (=1 if death, 0 otherwise)	13,109	0.00565	0.074924	0	1
Infant (=1 if death, 0 otherwise)	13,109	0.01877	0.135702	0	1
Under5 (=1 if death, 0 otherwise)	13,109	0.02449	0.15456	0	1
Motherage (age of the mother) years	11,549	39.8146	15.0194	11.5	99
Motherage2 (square of mother's age in years)	11,549	1810.765	1434.998	132.25	9801
Yearsch_m (years of schooling of the mother)	11,389	4.27904	5.43363	0	18
Hhyearsch (years of schooling of household head)	12,881	5.6892	5.9008	0	18
Genderhh (=1 if female, 0 otherwise)	13,103	0.29711	0.457001	0	1
Rurban (residence is 1 if rural, 0 otherwise)	13,101	0.64148	0.47958	0	1
Age60 (proportion of those aged over 60 years	13,101	0.07693	0.19766	0	1
Healthpercent (household expenditure on health/ total household expenditure)	12,784	2.4589	5.8937	0	94.8697
Lnpreventivexp (log of	13,103	16.7492	.5658	15.4134	18.1189

government expenditure on preventive health)					
Preventive_hhpct (interaction between *Healthpercent* and *Lnpreventive*)	12,784	41.1579	98.6488	0	1548.427
Healthexpresid (10^{-6}) (predicted residuals)	11,179	0.00045	6.03275	-4.028144	91.2809
Healthexpresid2 (predicted residuals squared)	11,179	36.39081	248.2383	0.00000199	8332.205
Healthpct_resid (interaction of *Healthpercent* and *Healthexpresid*)	11,179	36.39081	261.6795	-3.727371	8659.789

The results show that on average, a household spends 2.5 percent of its income on healthcare, which translates to Kshs. 4,529 per year. However, there were extreme cases where some households were not spending anything on health, whereas others spent up to 95 percent. Expenditure by the government shows that on average Kshs 22.1mn was spent on preventive healthcare per district. These funds are disbursed to district and sub-district hospitals, health centres and dispensaries. The funds are utilized directly for preventive health services, hence, no salary expenses are included.

Table 5.1 also contains descriptive statistics for control variables used in the analysis, including age of the mother, years of schooling, gender of household head, and residence variables.

5.1 Health Expenditures and Neonatal Mortality

We present the coefficient and standard errors of all the coefficients for factors used in the neonatal model that analyze the relationship between household and government expenditures on health, and child health outcomes (measured through neonatal mortality). Table 5.2 presents results for both linear probability model (LPM) labelled (1) and the Control Function Approach (CFA) models labelled (2) and (3). The interpretation of the coefficients and sizes of the parameters follow similar studies in this area like Oleche (2011), which later enables us to compare our findings.

Table 5.2: Effects of household and government expenditures on neonatal mortality

Variables	**Estimation methods**		
Dependent variable: *Neonatal mortality*	**LPM(1)**	**CFA (2)**	**CFA (3)**
Healthpercent	-.0009804 (.0034982)	-.01164 (.0146)	-.01463 (.01281)
Lnpreventive	.0001301 (.0014815)	-.00117 (.00234)	-.00148 (.00216)
Preventive_hhpct	.000089 (.000209)	-.000059 (.000227)	-.0000593 (.000228)
Healthexpresid		.014975 (.01412)	.01796 (.01229)
Healthexpresid2		.0008675** (.000387)	.000861** (.000389)
Healthpct_resid		-.000855** (.000386)	-.000849** (.000388)
Motherage	-.0004224* (.0002453)	-.000273 (.000286)	-.0002417 (.000281)
Motherage2	0.00000232	.00000328	0.00000345

	(0.00000257)	(0.00000285)	(0.00000276)
Yearsch_m	-.0004894*** (.0001536)	-.000378* (.000193)	
Hhyearsch			-.000458*** (.000157)
Genderhh	-.0024634 (.001689)	-.005123 (.003354)	-.00662** (.00296)
Rurban	.0023294 (.001776)	-.002335 (.00535)	-.00385 (.00487)
Constant	.0168962 (.025202)	.067905 (.06716)	.08160 (.0596)
Observations	11179	11179	11103
F-statistics	5.97	5.21	5.61
p-value	0.0000	0.0000	0.0000
R^2-squared	0.0043	0.0051	0.0055
Adjusted R-squared	0.0035	0.0041	0.0045

Standard errors of estimated coefficients in parentheses
Significance levels: *** = 1%
** = 5%
* = 10%

From the LPM model results (1), *Healthpercent* and *Lnpreventive* do not significantly influence neonatal mortality. The LPM results (1) show that *Healthpercent* (private/household expenditure) has a positive influence on neonatal mortality, that is, a one unit change in *Healthpercent* results to an increase in the probability of neonatal mortality by 0.0005103[23]. The same for *Lnpreventive* (government health expenditure on preventive care), which is 0.000349, indicating that an increase in *Lnpreventive* increases neonatal mortality probability by 0.000349.

[23] Note that the real impact of *healthpercent* is a partial derivative of *neonatal* by *healthpercent* as defined earlier in equation 4.13a. In this case, it is given by d*neontal*/d*healthpercent(1)*=(-.0009804 +.000089*16.7492)

These results are against our hypothesis that an increase in health expenditures reduces neonatal mortality. This is an indication that *Healthpercent* is endogenous and the LPM (1) has not controlled for endogeneity, hence the inconsistent results. This means that there are some omitted variables whose effect is in the error term, which is correlated with that of *Healthpercent*. Therefore, the true impact of *Healthpercent* is not reflected due to contamination of the estimation results. Some of these omitted variables are not measurable because they could include the effect of cultural practices like female genital mutilation (FGM), which are known to increase the probability of neonatal mortality (UNICEF, 2008; WHO Study Group, 2006; and WHO, 2000).

To deal with the endogeneity problem, this study used the instrumental variables approach to predict the residuals of the endogenous regressor, *Healthexpresid*, which we squared and labelled *Healthexpresid2*. We also interacted the residuals with *Healthpercent* to get a new regressor labelled *Healthpct_resid* to control for heterogeneity. The instrument we used is A*ge60*, that is, the proportion of those aged 60 years and above in a household, because the findings from the literature (Hammer and Prskawetz, 2012; Olaniyan *et al*., 2010) show that those aged 60 years and above spend more on healthcare. The instrument also satisfies all the conditions necessary for an instrumental variable like being exogenous and being correlated with the endogenous regressor. We tested the strength of the instrument using *Durbin-Wu-Hausman* test and the results of the F-statistic are presented in the appendices (Appendix Table A4). The *F*-statistic of 11.96, with only the exclusion restriction in the equation satisfies the test condition that an instrument is strong if $F > 10$.

The three variables emanating from the predicted residuals, *Healthexpresid*, *Healthexpresid2*, and *Healthpct_resid*, are introduced in our estimated equations through the control function approach. The purpose of the exercise is to reduce the effect of the unobservables in the error term that are correlated with *Healthpercent*, hence causing endogenity. As *Healthexpresid* controls the suspected endogeneity problem, *Healthpct_resid* deals with the suspected heterogeneity problem. The results of this specification are presented in Table 5.2 columns (2) and (3). In the models for control function approach, we introduce *Hhyearsch* to analyze the effect of the household head level of schooling on child health.

The results show that on inclusion of the predicted residuals, *Healthexpresid*, *Healthexpresid2*, and the interaction term *Healthpct_resid*, the effect of *Healthpercent* on neonatal mortality improves 25 times, an indication that the effect of the omitted variables in the residuals on *Healthpercent* has reduced significantly. Nevertheless, even after controlling for endogeneity and heterogeneity, the coefficient of the treatment variables improves in magnitude and acquires the hypothesized signs, but still the effect of each on neonatal mortality is insignificant. However, further analysis reveals that a one-unit increase in *Healthpercent* (private/health expenditure on health) reduces *neonatal mortality* probability by 0.0013 and 0.015 from model (2) and (3), respectively. However, *Lnpreventive*, which is government expenditure on preventive healthcare, reinforces the effect of *Healthpercent* on neonatal mortality and some other unobservable factors contained in the residuals. This conclusion is made after testing the hypothesis that the joint effect of *Healthpercent, Preventive_hhpct and Healthpct_resid* is zero. With an *F*-statistic of 2.05 and a prob>F=0.1052 in (2), we fail to reject the null at 1 percent, 5

percent and 10 percent levels that their joint effect is zero. However, in (3) we reject the null at 10 percent level. This implies that the effect of household and government expenditure on neonatal mortality is negative, but of low magnitude but only when the two players invest in healthcare together.

This means that both household and government have to invest in healthcare for the child health benefits of medical care to be realized. Without this joint effort, the results show that what matters for neonatal mortality is solely due to the mother's and the household's head years of schooling. These variables represent the human capital level in a household. We note two things: first, the *Yearsch_m* and *Hhyearsch* enter the equations as control variables. Therefore, their effect on neonatal mortality is not causal like in the case of the treatment variables, *Healthpercent* and *Lnpreventive*, but it is a correlation. Therefore, more years of schooling is associated with a reduction in neonatal mortality. Secondly, the highly significant effect of *Hhyearsch* shows that it is beneficial to have not only a household head who is more educated, but also an educated mother in the household. The gender dummy, G*enderhh*, also returns a negative and significant effect in model (3). This implies that having a woman as a head of the household is associated with reduced probability of experiencing neonatal mortality. The effects of the three variables, *Yearsch_m, Hhyearsch,* and *Genderhh*, show that the environment in which a mother is operating in has greater influence on neonatal mortality when private household expenditure and government expenditure are working independently. The results also confirm that neonatal mortality is affected more by the environment created by the mother for the child, rather than by the household expenditure on healthcare. In general,

having women heads of households increases the probability of having better child health outcomes.

5.2 Health Expenditures and Infant Mortality

Table 5.3 presents the results of the factors that influence infant mortality, hence health outcomes. Like in the case of neonatal mortality, the model for infant mortality contained variables suspected to be endogenous. The suspected variable was household health expenditure (*Healthpercent*), which was instrumented by older household members, the variable *Age60*. The results from the instrumented model are presented in columns labelled (2) and (3). The test for endogeneity and weakness of the instrument followed the same procedure as in the neonatal model. The test reported an F-statistic of 11.96, with a p-value of 0.0005 (See appendix table A4). This indicates that the variable age60, which was used as an instrument was strong. In addition, for the theoretical reasons highlighted earlier, the instrument was more valid among the others tested[24].

In estimating the causal effect of health expenditures on infant mortality, we considered both the effects of treatment and control variables. Thus, *Healthpercent* being the treatment variable gives us the causal effect of private health expenditures on infant mortality, while the coefficients of control variables are interpreted as correlations. Table 5.3 presents the coefficients and standard errors of the variables for the LPM (1) and the control function approach models (2) and (3).

[24] We tested for those aged 15 years and above, consumption of alcohol, and consumption of tobacco as possible instruments identified from literature.

Table 5.3: Effects of household and government expenditures on infant mortality

Variables	**Estimation Methods**		
Dependent variable: *Infant mortality*	**LPM(1)**	**CFA (2)**	**CFA (3)**
Healthpercent	.0062363 (.0062332)	-.0235506 (.026019)	-.0409716 (.02588)
Lnpreventive	-.0011265 (.0026397)	-.0048709 (.0041723)	-.007522* (.004365)
Preventive_hhpct	-.0003322 (.0003725)	-.000598** (.000405)	-.00104** (.000461)
Healthexpresid		.0371611 (.025173)	.064088** (.024821)
Healthexpresid2		.0010242** (.000689)	.001699** (.000785)
Healthpct_resid		-.001031** (.000688)	-.001704** (.000783)
Motherage	-.001182*** (.0004371)	-.0008108* (.0005103)	0008372 (.000567)
Motherage2	.00000530 (0.00000458)	8.19e-06 (5.08e-06)	.0000115** (5.57e-06)
Yearsch_m	-.0014091*** (.0002737)	-.00113*** (.000344)	
Hhyearsch			-.00134*** (.00032)
Genderhh	-.0052333* (.0030088)	-.012333* (.00598)	-.02113*** (.00598)
Rurban	.0060135* (.0031639)	-.00632 (.009528)	-.0119397 (.00984)
Constant	.0791304* (.0449054)	.2195214 (.1197)	.33828*** (.1205)

Observations	11,179	11,179	11,103
F-statistics	12.28	9.38	9.47
p-value	0.0000	0.0000	0.0000
R^2-squared	0.0087	0.0092	0.0093
Adjusted R-squared	0.0080	0.0082	0.0083

Standard errors of estimated coefficients in parentheses
Significance levels: *** = 1%
** = 5%
* = 10%

Results from the LPM model indicate that a one unit increase in *Healthpercent* increases the probability of infant mortality by 0.000672. The coefficient has the wrong sign although significant. This could be due to the presence of endogeneity and suspected heterogeneity. The positive sign of *Healthpercent* reflects the impact of omitted variables, whose effect is concentrated in the error term. The coefficient on *Healthpercent* is positive because of the intensity of the disease burden to the household. Since this effect is not captured in the model, the *Healthpercent* coefficient of 0.000672 represents the erroneous impact of *Healthpercent* to infant mortality. It also implies that because of the high level of disease burden, when a household treats a child say for malaria or diarrhoea, the child is likely to get sick of another disease, like measles because it may not have been immunized. This intensity of disease burden, which is not controlled for in the LPM contaminates the estimated coefficients. Hence, they are wrong.

The results also show that the impact of government expenditure on infant mortality is negative, that is a unit increase in *Lnpreventive* reduces infant mortality by 0.0000194. The effect is not only negligible but is insignificant. This is also associated with the presence of endogeneity in the model.

As highlighted in the case of neonatal mortality, we used an instrument, *Age60*, to predict the residuals for household health expenditure (the treatment variable) to correct for endogeneity and at the same time, we interacted *Healthpercent* with *Healthexpresid* to get *Healthpct_resid* to control for the suspected heterogeneity of child health. The results after controlling for endogeneity and heterogeneity are presented in columns (2) and (3). Using the control function approach, the results for our variable of interest, the coefficient on *Healthpercent*, improves tremendously. The coefficient improves almost 50 times in (2) and 86 times in (3) compared to the LPM estimates. The outcome shows that an increase in *Healthpercent* by one unit reduces the probability of infant mortality by 0.034 in (2) and 0.06 in (3). However, the estimated coefficients for (2) are statistically insignificant, meaning that the effect of private health expenditure on child health is negligible and the coefficient is not different from zero.

On the other hand, an increase in *Lnpreventive* reduces infant mortality, but its effect is about 6 times lower than that of *Healthpercent*. The results show that in (2), the effect of *Lnpreventive* is negative but not significant. Thus, although *Lnpreventive* reduces infant mortality, the impact is very small, if any. However, *Preventive_hhpct* posts a negative and highly significant effect. This represents the effect of interaction between private and public health expenditure. It therefore reflects the joint impact of private and public health expenditure on infant mortality. Note that the coefficient of the interaction term was not significant in the LPM, but is significant in the CFA (2) and CFA (3), when we include the predicted residuals in the estimated models.

The coefficient on *Preventive_hhpct* supports the complementarity hypothesis in household health economics that when one health risk is removed, an incentive is created

to remove yet another risk (Becker, 2007; Dow *et al*., 1999). This implies that for household or government expenditure on health to be effective, each player has to play his/her role. Thus, if for instance the government does not provide vaccines for children's immunization against measles or polio, any health expenditure on the child by the household may be wasted. The household is aware that even if their child is cured against malaria, he/she is likely to die because of measles, which he/she is not immunized against. However, if the child is immunized against major diseases like measles, a household is likely to take their child to hospital to be treated against say malaria because they are aware that upon cure, they are not likely to die of measles, in accordance with the complementarity hypothesis. In this case, the burden of diseases in a household is reduced. Thus, upon testing the null hypothesis that the joint effect of *Healthpercent, Preventive_hhpct,* and *Healthpct_resid* is zero, we reject the null at 5 percent because the F-statistic of 3.13 has a *p-value* 0.0244. This confirms the results that household and government investments in health have to be undertaken jointly for positive results on child mortality to be observed.

The control variables, *Yearsch_m, Genderhh,* and *Motherage2* have a negative coefficient in the infant mortality equation. *Motherage and Yearsch_m* represents the human capital of the mother, whereas *Genderhh* represents the environment in which the mother is bringing up her child. Therefore, older mothers and women with more years of schooling are able to reduce the probability of infant deaths in a household. A household headed by a woman reduces the probability of experiencing infant mortality. This implies that older mothers, those who are more educated and women heads of households,

contribute significantly to improving child health. They reflect the effect of women empowerment in child health.

5.3 Health Expenditures and Under Five Mortality

Table 5.4 presents results where our measure of health outcome is under-five mortality. In this case, we also report the results of three models that include LPM (1), and control function estimates (2) and (3). Our instrument for the suspected endogenous variable is still *Age60*, which we use while predicting reduced-form residuals of the endogenous regressor. The results are presented for both our main variables of interest, *Healthpercent,* and *Lnpreventive*, and the control variables. Both the estimated coefficients and standard errors are reported.

Table 5.4: Effects of household and government expenditures on under-five mortality

Variables	**Estimation methods**		
Dependent variable: Under-five mortality	**LPM(1)**	**CFA (2)**	**CFA (3)**
Healthpercent	.0114476 (.0070973)	-.0107046 (.0296234)	-.0409716 (.0258783)
Lnpreventive	-.001415 (.0030056)	-.00414 (.0047503)	-.0075223* (.0043652)
Preventive_hhpct	-.000622 (.0004241)	-.001045** (.0004605)	-.001049** (.000461)
Healthexpresid		.0339865	.0640877**

		(.0286602)	(.024821)
Healthexpresid2		.0017365**	.00169 **
		(.0007844)	(.000785)
Healthpct_resid		-.001742**	-.001704**
		(.0007828)	(.0007829)
Motherage	-.0014587***	-.0011308*	-.0008372
	(.0004977)	(.000581)	(.0005672)
Motherage2	.00000628	8.66e-06	.000012**
	(0.00000522)	(5.78e-06)	(5.57e-06)
Yearsch_m	-.0018014***	-.00157***	
	(.0003116)	(.000392)	
Hhyearsch			-.00134***
			(.0003177)
Genderhh	-.0065777*	-.0126618*	-.02113***
	(.0034259)	(.006805)	(.00598)
Rurban	.0100085***	-.0005616	-.0119397
	(.0036024)	(.0108475)	(.00984)
Constant	.0981167*	.2098748	.33828***
	(.0511301)	(.1362795)	(.12045)
Observation	11,179	11,179	11,103
F-statistics	16.57	12.66	12.68
p-value	0.0000	0.0000	0.0000
R^2-squared	0.0117	0.0123	0.0124
Adjusted R	0.0110	0.0113	0.0114

Standard errors of estimated coefficients in parentheses
Significance levels: *** = 1%
** = 5%
* = 10%

As in the case of infant mortality, the LPM coefficient of *Healthpercent* (0.00103) is positive and insignificant, which is against our expectation. However, *Lnpreventive* is

negatively correlated with under-five mortality, but the estimated effect is also insignificant. The positive and insignificant coefficients on *Healthpercent* and *Lnpreventive* strengthen our suspicion on existence of endogeneity and heterogeneity, even in the under-five mortality model. We include an interaction term for *Healthpercent* and *Lnpreventive (Preventive_hhpct),* in the model whose effect is also insignificant as shown in column (1).

Like in the case of neonatal and infant mortality models, we correct the under-five model for endogeneity by including the predicted residuals (*Healthexpresid, Healthexpresid2*) and the interaction term between *Healthpercent* and *Healthexpresid (Healthpct_resid),* which controls for heterogeneity. In the LPM model (1), a unit increase in *Healthpercent* leads to an increase in under-five mortality by 0.00103. Controlling for endogeneity and heterogeneity, the estimated coefficient improves in magnitude, such that an increase of *Healthpercent* by one unit in (2), reduces the probability of under-five by 0.03 and in (3) by 0.06. This implies that the *Healthexpresid* now pins down the effect of the omitted variables and we are able to get the real impact of *Healthpercent* on under-five mortality. Some of the omitted effects include cultural and religious beliefs like witchcraft and supernatural powers in cure of diseases. Health expenditure and utilization surveys in Kenya have documented evidence that some households fail to visit health facilities because of religious and cultural reasons (MoH, 2003 and 2009). These factors would otherwise have been in the error term; hence, the cause of endogeneity problem. However, their effect is now captured by *Healthexpresid* and *Healthpct_resid*. The coefficients of these two variables are highly significant in models (2) and (3) implying

that they are associated with some unobservable factors as described above that impact on *Healthpercent*, hence the under-five mortality.

The estimated effects of *Healthpercent, Lnpreventive,* and *Preventive_hhpct* are quite intuitive. They show that private (*Healthpercent)* and government (*Lnpreventive*) expenditure alone have insignificant effects on under-five mortality. However, when household and government cooperate to provide health inputs (*Preventive_hhpct*), the effect of their joint investments in health is significant. There is a reduction in under-five mortality, implying an improvement in child health. To ascertain this, we carried out an F-test for the joint significance of the coefficients on *Healthpercent, Preventive_hhpct,* and *Healthexpresid* for models (2) and (3) and rejected the null at five percent (F=2.77, *p*-value 0.0398) and one percent (F=4.22, *p*-value 0.0055), respectively, that their joint effect is zero. This further confirms the complementary role between household and government investments in improving child health.

From this analysis, most of the control variables are also correlated with under-five mortality; they include *Motherage, Yearsch_m, Hhyearsch,* and *Genderhh*. This implies that the number of years of schooling of the mother and that of the household head are negatively correlated with under-five mortality. Thus, the more the years of schooling of the mother and the household head, the lower the probability of experiencing under-five mortality. People that are more educated are associated with lower poverty levels, better nutrition, and high observance of hygiene, which reduces episodes of illness, thus lowering incidences of child mortality in a household (Cutler and Adriana, 2006).

CHAPTER SIX: SUMMARY, CONCLUSION AND POLICY IMPLICATIONS

6.1 Summary and Conclusion

This study has analyzed the effect of health expenditure on child health outcomes in Kenya. The analysis used a household level data from the KIHBS, which was collected in 2005/06 period and enriched with county level data on government health expenditure. The study used linear probability and control function models to estimate the impacts of private and government expenditure (as health inputs) on neonatal, infant, and under-five mortality (proxies for health outcomes). Control variables that define the operating environment of the households and especially mothers, were included in structural equations.

After estimating the LPM model for each child health outcome, the results showed the presence of endogeneity and heterogeneity. The LPM estimates for endogeneity and heterogeneity bias were corrected using a control function approach. On introducing the predicted residuals, the effect of omitted factors that were the source of endogeneity was pinned down and we were able to estimate the true impacts of health expenditures on mortality. Secondly, the control for bias due to heterogeneity was achieved by interacting the predicted residuals and health expenditure variables.

By introducing the predicted residuals and the health expenditure interaction term, together with household head years of schooling through the control function approach,

the models fit the data better than when they are introduced in the LPM model[25]. After estimation of the final models, the results showed that factors that influence child health outcomes depend on the health measure used. This could be the reason why different studies have used different measures of health outcome like life expectancy (Nixon and Ulman, 2006), infant mortality (Cremieux *et al*., 1999), and child mortality (Oleche, 2011).

One of the findings of the thesis is that medical inputs matter in the production of child health but not at all ages of a child. However, there are other factors, which may reduce the effectiveness of the health or medical inputs. The results show that the impact of health inputs on health outcomes depends on whether both households and the government are cooperating in the health investments. For instance, we found that when the effects of household and government health expenditure are analyzed separately, their effects on child mortality are negative, but not significant for all measures of child health. However, when the two are interacted, their effect is not only negative but also highly statistically significant in infant and under-five mortality equations. This is because each of the two players has distinct roles to play in provision of healthcare services that improve child health. Thus, when the government immunizes children, the household should provide hygienic conditions for the growing child, including nutrition. In addition, when a child is immunized, the household is aware that the risk of that child dying from immunizable diseases is reduced drastically, hence the parents have an incentive to take the child to the hospital whenever he/she is ill. However, when the child is not immunized and falls sick the parent knows that taking him/her to hospital may not be a

[25] There are more results from different specifications in Appendix Table A5, A6, and A7. On comparison, the current specification remains superior.

solution because even if treated, the child could easily die of another dangerous disease that he/she has not been immunized against. This is the important complementarity hypothesis that removing one risk to child health means that there is an incentive to remove other risks to a child's health (Becker, 2007; Dow *et al*., 1999).

The results suggest that there are other important factors that influence child mortality apart from expenditure. For instance, the gender of the head of household, education of the mother, and the education of the head of household, all matter importantly for child health. These variables had highly statistically significant coefficients in mortality equations. Okurut (2009) found a positive and significant effect of mother and husband's level of education on child health. Generally, what the results reflect is that the status of a mother in a household is very important in the reduction of child mortality. For instance, when a woman is the household head or when the household head is more educated, the probability of mortality in the household is greatly reduced than in a less educated household head. The probability may even be further reduced, if the woman is not only educated but is also the head of the household, or if a household has an educated mother. This suggests the importance of empowering women in decision-making, especially in areas related to the health of children.

The results from our control function models reveal that there are hidden factors that affect negatively the child health. Since some of these factors are not measurable, their effect on health is normally in the error term. These variables cause endogeneity; hence, we neutralized their effects by predicting the residuals of the household expenditure and including them in the estimation model. These factors probably include cultural practices

like FGM, witchcraft and religious beliefs. Unless the effects of such factors are controlled for, we may not get reliable results on factors that affect child mortality.

In conclusion, the following observations were made: the impact of private expenditure on child health outcomes is insignificant when it is the only source of health inputs. Likewise, the impact of government investment in health has insignificant impact on child health outcomes, if there are no complementary investments by households. Therefore, to get positive impacts of health inputs on child health outcomes, households and the government need to invest together in child health.

The impact of health inputs on health outcomes differ depending on the measure of health outcomes being considered. For instance, while private and government expenditures have a combined negative impact on infant and under-five mortality, it is the household environment in which the mother operates from, that has a significant influence on neonatal mortality. Control variables like gender of the household head, years of schooling of the mother and those of the household head, indicate the important role played by the mother and women in general, in mediating the effects of the interventions designed to improve child health.

Therefore, this study makes the following contributions to the existing body of knowledge in the health economics discipline. First, the true effect of health expenditures on child health are fully captured using the control function approach. Secondly, the study has established that there is complementarity between private and government health expenditures in the promotion of child health. Hence, both the households and the government have to invest jointly in order to effectively reduce competing risks to child's health. Third, the study's methodology captures the health effect of non-health inputs on

child mortality. These inputs include the human capital of the mother and of the household head. Detection of these effects was possible through employment of the control function approach to estimate child health models. Fourth, the study has established that there is complementarity (in child health advancement) between health expenditures and unobservables of medical and non-medical variety. Examples of these unobservables include cultural and religious influences on healthcare uptake and ineffectiveness of children's medicines when not properly administered. Fifth, the impact of health expenditure on child health depends on age of the child. For neonates, the mortality effect of health expenditure is zero, but the effect of human capital of the mother is substantial. Sixth, the health effect of human capital variables (education and age) of the mother is statistically significant irrespective of the age of the child. Thus, raising the social and economic status of the mother is a powerful strategy for improving child health in Kenya, and in other countries at a similar level of development.

6.2 Policy Implications

Provision of health inputs or investments to improve child health should be a cooperative effort between households and the government. The government should provide adequate preventive healthcare services and at the same time, households should take up their role in the provision of private health inputs, such as treatment for non-immunizable childhood diseases. Thus, as government takes up its immunization role, households should not only take their children to health facilities for treatment against preventable diseases (like malaria and diarrhoea), but also enhance nutrition and hygiene for the children.

The fact that health expenditures react differently to the different child health measures means that different policy strategies should be employed to deal with health challenges of the age groups. For instance, to reduce neonatal mortality, the environment at which the mother gives birth is very important. This calls for the need to increase the number of skilled birth attendants in the country. This could be made possible by ensuring that all community health workers have basic training on mid-wifing. For the infants, there should be continuous campaigns for full immunization. With the current high level of access to cell phones, health facilities should embrace the technologies and send reminders to parents when immunization dates are due.

It has been recognized that the public interest in provision of services is first to vulnerable groups in the society, which includes women and children. To enable vulnerable children (especially from poor households) access government health services, there is need for targeted programmes that enhance the accessibility. This includes re-imbursement programmes where households are re-imbursed for say taking their children for immunization. This should be integrated into the current social protection policy and conditional cash transfers for orphans and vulnerable children (OVC). This would deal with some of the unobservable factors like opportunity cost of time, which this study has shown that they impact negatively on child health.

The socio-economic status of the mothers should be improved in order to enhance their effectiveness in producing child health. Women empowerment can be undertaken through investment in education, and especially in programmes that improve the reproductive health. Further, interventions that enhance the decision making of mothers in areas of nutrition and hygiene are important for child health. Women empowerment

and decision-making efficiencies of mothers are some of the factors that we hypothesize to be present in the residual term of the structural child mortality equations. These and other factors should be addressed if the effectiveness of investments in child health is to be realized. Such interventions might require programmes to address FGM and other cultural and religious barriers that we hypothesize might be acting negatively on women's health and that of their children.

6.3 Areas for Further Research

This study was only able to estimate direct impacts of health expenditures on child health outcomes. However, the study could not establish the impacts of other important factors that were suspected to have an influence on health outcomes. These factors include FGM, witchcraft, and religious beliefs. Undertaking such a study to measure these impacts could assist in designing policies to tackle the challenges associated with poor health of mothers and children in poor communities. The effects of inequalities in resource distribution on child health need an additional investigation using different data sets.

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APPENDICES

Table A1: Public and private health facilities, 2009

Controlling agency	Hospitals	Health centres	Dispensaries	Maternity & Nursing Homes	Clinics	Total
Ministry of Health	254	460	2,290	-	-	3,004
Faith Based Organization & Other NGOs	81	150	561	11	128	931
Other Public Institutions	5	49	291	-	56	401
Private	110	56	185	143	1,722	2,216
TOTAL	450	715	3,327	154	1,906	6,552

Source: Ministry of Health (2010)

Table A2: Infant and child mortality rates

Year	Infant mortality rate (per 1,000 live births)	Under 5 mortality rate (per 1,000 live births)
1948	184	-
1962	126	219
1969	119	190
1979	104	157
1989	59	113
1993	62	93
1998	74	112
2000	73	116
2003	77	115
2006	60	92
2008-09	52	74

Sources: Ministry of Health (2010)

Table A3: Full immunization coverage rates for children under one year

	2002		2003		2004		2005		2006	
Provinces	No.	%	No.	%	No.	%	No.	%	No.	%
Nairobi	50,883	60	77,859	90	67,192	70	74,570	75	77,178	75
Central	74,070	60	99,933	78	100,181	83	112,931	93	106,226	88
Coast	55,392	52	72,232	66	61,716	55	68,727	61	86,471	75
Eastern	100,744	56	115,520	62	121,537	83	127,155	67	144,671	75
N/Eastern	12,525	45	19,077	66	18,051	55	16,228	48	25,556	73
Nyanza	58,022	30	94,808	47	96,249	48	107,842	53	132,739	65
R.Valley	129,745	42	156,041	49	160,199	49	189,860	57	226,604	66
Western	73,115	45	95,690	57	96,200	53	103,006	57	107,917	58
National Coverage	554,446	47	731,160	60	721,325	59	800,319	63	907,362	70

Source: KNBS and ICFMacro (2010)

Table A4: Durbin-Wu-Hausman Test for the validity of age60 as an instrument

Healthpercent	**Coefficient**	**Std. Err**	**t**	**P>|t|**
age60	.91671	.26508	3.46	0.001
_cons	2.38873	.05592	42.72	0.000
Number of obs = 12,784 F(1, 12782) = 11.96 Prob > F = 0.0005 R-squared = 0.0009 Adj R-squared = 0.0009				

Table A5: Effect of household and government expenditures on neonatal mortality

Variables	Estimation methods				
	Baseline IV	**IV without expenditure interactions**	**CFA without household & government expenditure interactions**	**CFA with income quintiles & schooling of mother**	**CFA with income quintiles & head's schooling**
Healthpercent	-.0050764	-.0055993	-.0056486	-.008748	-.01259
	(.0138187)	(.0127324)	(.01273)	(.014784)	(.01289)
Lnpreventive	-.0003584	-.0003945	-.0004605	-.000833	-.001223
	(.0023114)	(.002129)	(.002129)	(.002364)	(.002169)
Preventive_hhpct				-.0000621	-.0000637
				(.000227)	(.000228)
Healthexpresid		.0057628	.007916	.012115	.015967
		(.01273)	(.012762)	(.014305)	(.01237)
Healthexpresid2		.0000102*	.0008383**	.000868**	.0008599**
		(5.39e-06)	(.000358)	(.000387)	(.000389)
Healthpct_resid			-.000826**	-.000855**	-.000847**
			(.0003571)	(.000386)	(.000388)
Motherage	-.0001032	-.0000993	-.0000974	-.0003337	-.000308
	(.000263)	(.0002425)	(.0002424)	(.000293)	(.000285)
Motherage2				3.40e-06	3.79e-06
				(2.86e-06)	(2.78e-06)
Yearsch_m	-.000463**	-.000453**	-.000454**	-.000426**	
	(.0001967)	(.0001813)	(.0001812)	(.000204)	
Hhyearsch					-.000512***
					(.000166)
Genderhh		-.0036185	-.003647	-.004255	-.005929**
		(.0031)	(.0030995)	(.0034395)	(.002996)
Rurban	.0002061	.0000921	.000016	-.001122	-.00281
	(.005361)	(.004939)	(.004938)	(.005461)	(.004919)
Wealth _Quintile_2				.001544	.001648
				(.002495)	(.002502)
Wealth_Quintile_3				.002362	.002718

				(.002518)	(.002533)
Wealth Quintile_4				.003615 (.002569)	.004126 (.002582)
Wealth Quintile_5				.001721 (.002779)	.002524 (.00279)
Constant	.032616 (.063898)	.0340889 (.058867)		.054303 (.06816)	.071404 (.06007)
Observations	11179	11179	11179	11179	11103
F-statistics	4.28	6.32	6.21	3.96	4.30
P-value	0.0003	0.0000	0.0000	0.000	0.0000
R^2-squared	-	0.0045	0.0050	0.0053	0.0058
Adjusted R	-	0.0038	0.0042	0.0040	0.0044

Significance levels: *** = 1%

** = 5%

* = 10%

Table A6: Effect of household and government expenditures on infant mortality

Variables	**Estimation methods**				
	Baseline IV	**IV without expenditure interactions**	**CFA without interaction of household and government expenditures**	**CFA with expenditure interactions plus wealth quintiles & schooling of mother**	**CFA with expenditure interactions plus wealth quintiles & schooling of the head**
Healthpercent	-.016404 (.028016)	-.0160311 .0226908	-.016071 (.0226908)	-.019688 (.02635)	-.04194* (.02284)
Lnpreventive	-.0042724 (.004686)	-.004247 (.003795)	-.0043002 (.003795)	-.00439 (.004213)	-.006764* (.00384)
Preventive_hhpct				-.000604 (.000405)	-.0006002 (.0004043)
Healthexpresid		.016965 (.0226872)	.018708 (.022748)	.03339 (.025496)	.05552** (.021913)
Healthexpresid2		-7.30e-06	.0006628	.001031	.000999

		(9.60e-06)	(.0006382)	(.000689)	(.000688)
Healthpct_resid			-.0006685	-.001037	-.001005
			(.0006366)	(.000688)	(.000687)
Motherage	-.0003719	-.0003747	-.0003731	-.000893*	-.000681
	(.0005337)	(.0004321)	(.0004321)	(.000522)	(.000505)
Motherage2				8.36e-06	.0000105**
				(5.09e-06)	(4.92e-06)
Yearsch_m	-.001312**	-.001319***	-.0013196***	-.001203***	
	(.000398)	(.0003231)	(.0003231)	(.000363)	
Hhyearsch					-.001064***
					(.000294)
Genderhh	-.0086526	-.0086157	-.0086389	-.01118*	-.01738***
	(.006822)	(.0055247)	(.005523)	(.006130)	(.005306)
Rurban	-.0005137	-.0004325	-.0004941	-.004717	-.01325
	(.010868)	(.0088013)	(.0088014)	(.009732)	(.008713)
Wealth_Quintile_2				.003842	.003646
				(.004446)	(.004432)
Wealth_Quintile_3				.002943	.003605
				(.004488)	(.004487)
Wealth_Quintile_4				.004151	.004845
				(.004579)	(.004573)
Wealth_Quintile_5				.003145	.003457
				(.004953)	(.004939)
Constant	.1581838	.157135	.15806	.200703	.29329
	(.12955)	(.1049084)	(.104912)	(.121473)	(.10639)
Observations	11179	11179	11179	11179	11103
F-statistics	9.53	12.15	10.93	6.94	7.02
P-value	0.000	0.000	0.000	0.0000	0.000
R^2-squared	-	0.0086	0.0087	0.0092	0.0094
Adjusted R	-	0.0079	0.0079	0.0079	0.0081

Significance levels: *** = 1%

** = 5%

* = 10%

Table A7: Effect of household and government expenditures on under-five mortality

Variables	Estimation methods				
	Baseline IV	**IV without expenditure interactions**	**CFA without household and government expenditure interactions**	**CFA with expenditure interactions plus wealth quintiles & mother's schooling**	**CFA with expenditure interactions plus wealth quintiles & schooling of the head**
Healthpercent	-.0099586	-.0096268	-.00969	-.007261	-.03803
	(.0279178)	(.025839)	(.025837)	(.02999)	(.02604)
Lnpreventive	-.0045853	-.0045624	-.0046498	-.00376	-.00722*
	(.0046696)	(.004321)	(.004321)	(.004797)	.00438
Preventive_hhpct				-.00105**	-.001047**
				(.000461)	(.000461)
Healthexpresid		.0108984	.013748	.03071	.06131**
		(.025835)	(.0259)	(.02902)	(.02499)
Healthexpresid2		-6.50e-06	.001089	.001755**	.001715**
		(.0000109)	(.000727)	(.000785)	(.000785)
Healthpct_resid			-.001093	-.00176**	-.001719
			(.000725)	(.000783)	(.000783)
Motherage	-.000669	-.0006714	-.000669	-.00118**	-.000891
	(.0005318)	(.0004921)	(.000492)	(.000594)	(.000576)
Motherage2				8.66e-06	.0000116**
				(5.80e-06)	(5.61e-06)
Yearsch_m	-.001756	-.001762	-.001763	-.00159***	
	(.000397)	(.0003679)	(.000368)	(.000414)	
Hhyearsch					-.001356***
					(.000335)
Genderhh	-.0087484	-.008716	-.0087535	-.01179*	-.02034***
	(.006799)	(.006291)	(.006291)	(.006979)	(.00605)
Rurban	.0055734	.0056456	.005545	.000472*	-.01101
	(.01083)	(.01002)	(.010022)	(.01108)	(.009935)
Wealth quintile_2				.007259	.006911
				(.00506)	(.005053)

Wealth quintile_3				.003975 (.005109)	.004566 (.00512)
Wealth quintile_4				.002507 (.005214)	.003065 (.005214)
Wealth quintile_5				.002791 (.005638)	.002906 (.005633)
Constant	.1629356 (.12909)	.162002 (.11946)	.163515 (.11946)	.19285 (.13829)	.32352 (.1213)
Observations	11179	11179	11179	11179	11103
F-statistics	4.30	16.18	14.64	9.43	9.43
P-value	0.000	0.000	0.0000	0.000	0.0000
R^2-squared	-	0.0115	0.0117	0.0125	0.0126
Adjusted R	-	0.017	0.0109	0.0112	0.0113

Significance levels: *** = 1%

** = 5%

* = 10%