

**FACTORS INFLUENCING SUPPLY OF HEALTH INPUTS IN  
KENYA**

**BY:**

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*A research paper submitted to the Department of Economics, University of Nairobi, in partial fulfillment of the requirements for the Degree of Masters of Arts in Economics.*

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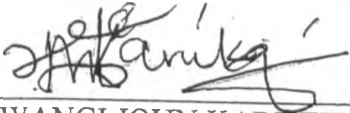
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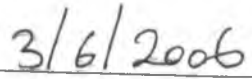
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## DECLARATION

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

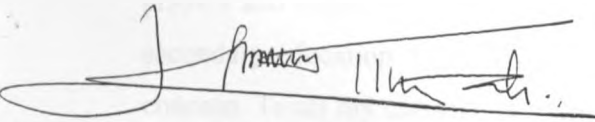


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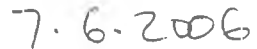


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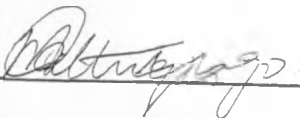
This research paper has been submitted for examination with our approval as university supervisors.



MR. URBANUS KIOKO



DATE



DR. MERCY MUGO



DATE

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To anyone else who contributed to this research paper in one way or the other, I sincerely thank you and say, "God Bless You Abundantly"

## DEDICATION

I dedicate this paper to my grandfather the late *Joseph Kamau Kaihu*.

You tirelessly encouraged me to work hard in school right from the primary level. It is on a clear record that you vigorously instilled discipline among your grandchildren me being one of them.

## ABSTRACT

Kenyan Health sector is highly sensitive as it plays the role of saving lives. The key strategy of curative and preventive measures forms the main goal for the sector. For the last three decades, this goal has not been successfully met. The failure is to quite a large extent attributed to lack of adequate health inputs particularly pharmaceuticals and non-pharmaceuticals especially in the public health facilities. Based on the existing literature and the available data, this paper provides a descriptive and empirical analysis of the factors that influence supply of pharmaceuticals and non-pharmaceuticals in Kenya. The paper's primary purpose is to identify the major determinants of supply of pharmaceuticals and non-pharmaceuticals in Kenya. This implies that the principal focus of this paper is to pursue an analysis of the relative importance of these determinants, followed by a proposal of measures to enhance supply of pharmaceuticals and non-pharmaceuticals aimed at equipping the public health facilities to the optimal level.

The major findings of the paper, based on a time-series regression model are that the charges of Healthcare, prices for pharmaceutical and non-pharmaceuticals, Gross Domestic Product (GDP) and population size all have statistically insignificant influences on the supply of pharmaceuticals and non-pharmaceuticals in the health sector. To improve efficiency in healthcare services, there is a need to sufficiently equip public health facilities given that majority of people in Kenya seeks medical care from these government owned health facilities. Efficiency in equipping these facilities would require to adopt policies which would not necessarily be based on product price, input unit price, Gross Domestic Product (GDP) and population size. This is principally attributed to the fact that the government is not a profit making entity in her role of providing public services such as healthcare to the public i.e. her citizens.

## ABBREVIATIONS

ADF	Augmented Dickey Fuller
ADL	Autoregressive Distributed Lag
ART	Antiretroviral therapy
BLUE	Best Linear unbiased estimators
CBS	Central Bureau of Statistics
D	Dispensary
DALY	Disability Adjusted Life Years
DFID	Department for International Development
DH	District Hospital
ECM	Error Correction Mechanism
GDP	Gross Domestic Product
GNP	Gross National Product
GOK	Government of Kenya
HBP	High Blood Pressure
HC	Health Center
HIPS	Highly Indebted Poor Countries
HIV/AIDS	Human Immune-Deficiency Virus/Acquired Immune-Deficiency Syndrome
IMR	Infant Mortality Rate
JB	Jarque Bera
KDHS	Kenya Demographic Health Survey
KEMSA	Kenya Medical Supplies-Agency
K£	Kenyan Pound
MLE	Maximum Likelihood Estimation
MOH	Ministry of Health
NGOs	Non-Governmental Organizations
OECD	Organization for Economic Cooperation and Development
OLS	Ordinary Least Squares
ORT	Oral Re-hydrated Therapy
PGH	Provincial General Hospital
PHC	Primary Health Care
QALY	Quality Adjusted Life Years
SDH	Sub-District Hospital

STI	Sexual Transmitted Infections
TB	Tuberculosis
TC	Total Costs
UNICEF	United Nations Children's Fund
VC	Variable Costs
WHO	World Health Organization

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# CHAPTER 1: INTRODUCTION

## 1.1 Background

Health is an asset whose value is highly significant. Values and goals such as education, shelter and security do exist in life, yet compared to health, they rank lower on the preference scale of most people (Zweifel, 1992). Indeed, health is a necessary precondition for success in other activities. Health care is a basic need, entitled to everyone (Wagstaff, 1986). Owing to these importances, medical care qualifies to be a merit good<sup>1</sup> such that equity should be ensured in its supply.

Kenyan population which is currently estimated to be thirty three (33) millions is quite vulnerable to illnesses. Diseases such as malaria, diarrhoea, respiratory problems, waterborne diseases such as typhoid and cholera, meningitis, and the HIV/AIDS pandemic are common (GOK, 2005). To cure and prevent these diseases, pharmaceuticals and non-pharmaceuticals must be provided to health workers who provide healthcare services to patients. Users and critics for government health care facilities place much emphasis on the availability of pharmaceuticals and non-pharmaceuticals and the most frequently heard complaint in Sub-Saharan countries is that pharmaceuticals and non-pharmaceuticals are only sporadically available (Vogel and Stephen, 1986). To yield maximum patients safety such as for surgical and anaesthetic procedures, it will require adequate pharmaceuticals and non-pharmaceuticals including medical equipment (Gaba, 2000). Baltussen et al, (2002) established that improving pharmaceuticals and non-pharmaceuticals availability in facilities has been identified as the main priority for health policy action. Pharmaceutical and non-pharmaceuticals are thus the health inputs to be considered in this research paper. Since these Pharmaceutical and non-pharmaceuticals are used by the health personnel to provide health

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<sup>1</sup> See Mwabu et al, (2004): A merit good is a good that qualifies to be made available to everybody irrespective of his or her ability to pay.

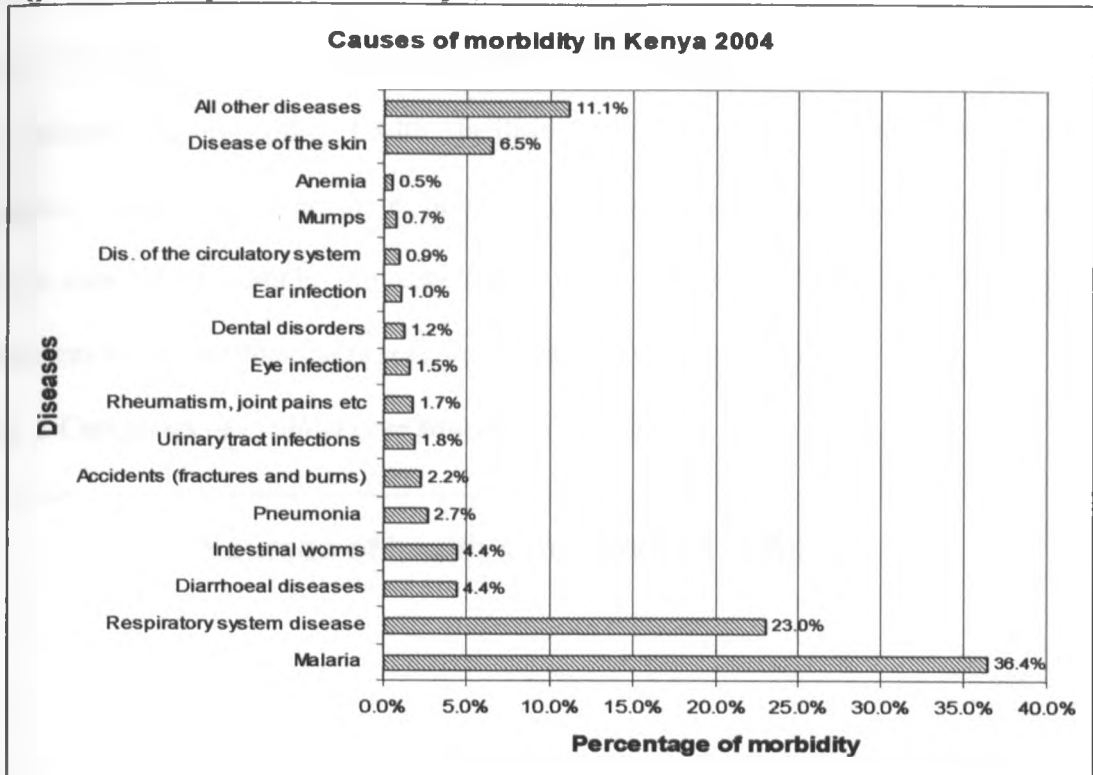
care, it then follows that they are both converted into the final product which is the health service. It therefore implies that, the quantity of the health inputs (i.e. both pharmaceuticals and non-pharmaceuticals) provided by the government is the quantity of the health services supplied by the government to the health public facilities.

Examples of pharmaceuticals supplied by MOH are anti-malarial drugs, anti-cholera drugs, pain killers, vaccines and laboratory reagents. Non-pharmaceuticals include syringes, microscopes, dressings like bandages and gauze, linen, autoclaves and hospital beds/cots.

However, the government considers morbidity when providing pharmaceuticals and non-pharmaceuticals to the health facility. For instance, if drugs are being procured by the government it should buy more drugs to cure or prevent a disease that contributes to higher morbidity and vice versa.

## Causes of morbidity in Kenya.

**Fig. 1. Morbidity situation in Kenya; 2005**



*Source: Economic Survey, 2005*

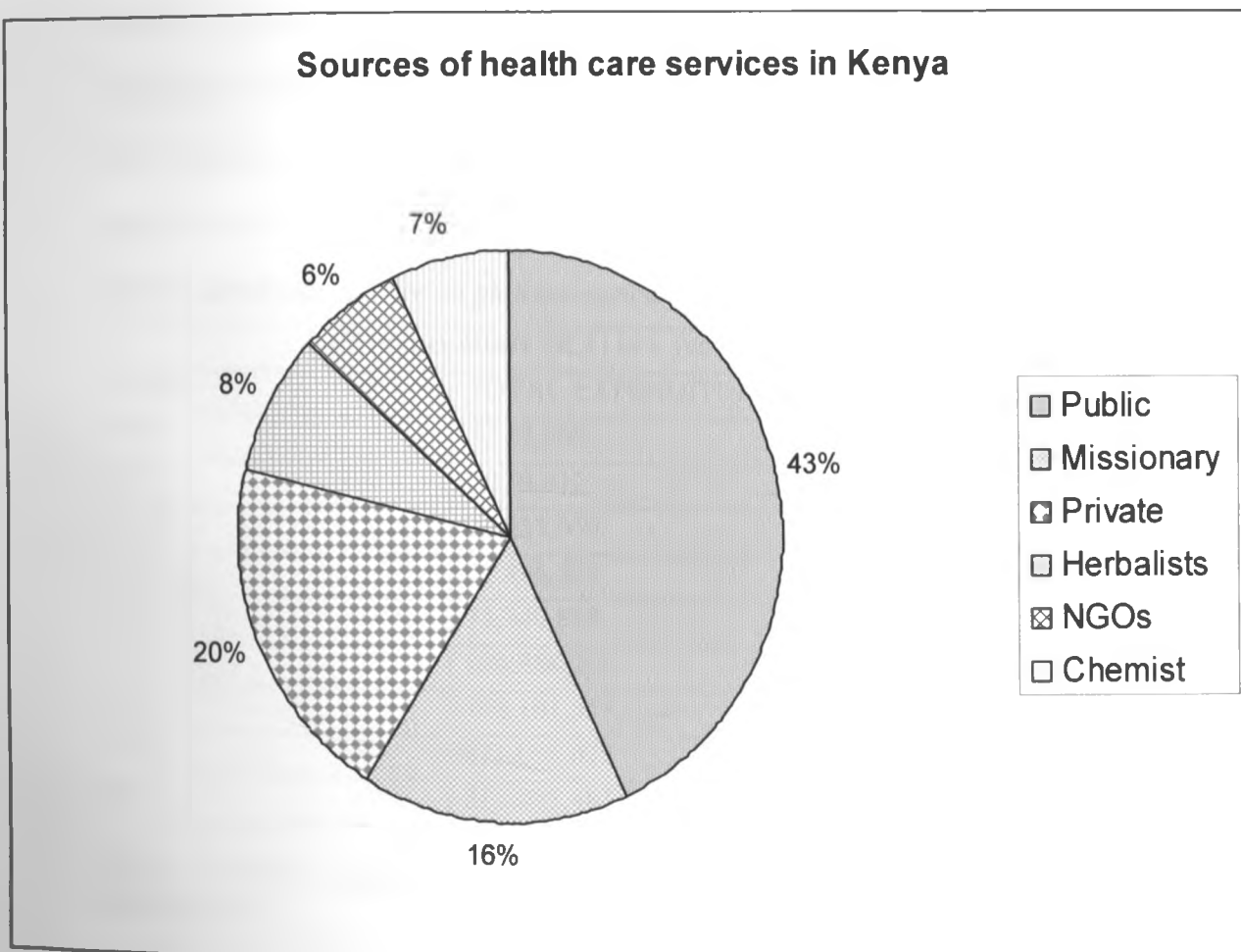
Basing sourcing of pharmaceuticals and non-pharmaceuticals by MOH on morbidity, figure 1 can be used as a guide. For instance, the ministry should extend a priority in procuring anti-malarial drugs given that malaria takes the lead in morbidity contributing to 36.4 per cent.

UNICEF (1990) identified vaccine and Oral Dehydrated Therapy (ORT)<sup>2</sup> as important health inputs. ORT is highly recommended for treating water borne diseases while vaccines are more cost effective and given that many conditions have negative externalities, UNICEF advised on distribution of the vaccine freely at highly subsidized prices. When the vaccine was distributed as advocated for by UNICEF, the outcome was that 80 per cent of the population got immunized against polio. In essence, vaccines are administered to induce

<sup>2</sup> Water solution with salt and sugar given to babies in order to rehydrate them after getting dehydrated out of excessive loss of water from their bodies caused by diarrhoea.

immunity against diseases such as polio, smallpox, measles, hepatitis and tetanus (Anderson, 2001). The government's commitment is to reduce the social, economic and health burden of diseases in the country (GOK, 2003). One of the ways through which the health problems can be reduced is to equip health facilities with adequate pharmaceuticals and non-pharmaceuticals. However, many public health facilities in the country are ill equipped to handle most of the complex illnesses affecting the population (Ngugi, 1999). Figure 2 below illustrates where health seekers seek health care services in Kenya.

**Fig. 2 Categories of medical care sources in Kenya**



*Source: Author's computation based on Ahmed et al, 2003.*

Figure 2 attests that the key health facility from which health care services are sourced in Kenya is public health facility. This justifies why the government should scale-up her efforts

in equipping the public health facilities with the required pharmaceuticals and non-pharmaceuticals.

As observed by Mnyika et al, (2004), Government health facilities experience problems in getting essential medical supplies such as surgical supplies and dressings. Health seekers prefer the facility with the regular supply of health inputs like drugs and high quality services (Ngugi, 1999). Many users of health services consider or equate the availability of pharmaceuticals and non-pharmaceuticals with quality of care (Kanji et al, 1992). Effective health inputs especially the antibiotics are commonly out of stock in government health facilities, a situation that hampers health care services in Kenya. Supply of these health inputs is assumed to be proxied by the expenditure incurred by MOH on these two categories of health inputs i.e. pharmaceuticals and non-pharmaceuticals. The quantity fluctuates from year to year in the country. This fluctuation is demonstrated in table 1 below.

**Table 1: MOH expenditure on pharmaceuticals and non-pharmaceuticals**

Total expenditure (K £) in a year	
YEAR	TOTAL EXPENDITURE (K £)
1970	7,183,000
1974	9,139,812
1979	22,421,359
1983	41,886,300
1987	71,740,888
1991	104,388,201
1994	168,101,557
1999	271,016,623
2003	211,825,483.1

*Source: Author's computation using GOK Recurrent Expenditure data on Health care, various years.*

As reflected in Table 1, the quantities of pharmaceuticals and non-pharmaceuticals that MOH provides to the public health facilities change over time. There is a substantial fluctuation

within five years period, especially the period between 1991-1994 and the period 1994-1999 whose rates of change were 61.04% and 61.22% respectively. These fluctuations are influenced by several factors. The factors are therefore to be studied in this research paper. The magnitude of the factors' influence on the supply of Pharmaceuticals and non-pharmaceuticals will be measured empirically in this study. In this case, the quantity of pharmaceuticals and non-pharmaceuticals consumed by MOH in production of health care will be the dependent variable while the influencing factors will be the explanatory variables.

## 1.2 The performance of the health sector

Supply of health inputs in Kenya affects the performance of the health sector. This performance can be assessed by indicators of human health. The indicators include; life expectancy<sup>3</sup>, HIV prevalence, fertility rate, and mortality rate (MR) etc. The trend of these indicators is depicted in table 2 below.

*Table 2 Trends of health indicators in Kenya*

	Indicator	Year	Indicator's size	% change
1.	Life expectancy	1999	47.02	21.67% drop
		2003	44.6	
2.	Mortality rate	1999	62.62 per 1000	12.5% drop
		2003	69.07 per 1000	
3.	National HIV prevalence	1999	14.3 %	7.2% drop
		2003	6.7%	
4.	Fertility rate	1999	5.2	5.77% drop
		2003	4.9	

*Source: KDHS 2000, Republic of Kenya 2002, 2003, 2004 and 2005.*

<sup>3</sup> The probable number of years a person will live after a given age is determined by the mortality rate in a specific geographical area. It may be individual, qualified by the person's condition or race, sex, age or other demographic factor.

From table 2 above, it is evident that there have been deterioration of health between 1999 and 2003 in general. For instance, there is a steady decline in the fertility rate between 1999 and 2003 that reflects a corresponding rise in the contraceptive prevalence <sup>4</sup> rate (MOH, 2003).

### 1.3 Problem Statement

The commonest way of maintaining and restoring ones health is by providing quality health care across the entire population spectrum. Accessing such reliable health care through the use of the health care institutions requires properly equipping them with the relevant health inputs. Growth in the health sector cannot be realized without supply of pharmaceuticals and non-pharmaceuticals (Mushi, 2004). In Kenya, supply of these health inputs has been occasionally linked to the macro-economic environment, the policy framework and other variables. The relative contribution of the factors which influence supply of pharmaceuticals and non-pharmaceuticals and their magnitudes are not fully known. Thus there exists an information gap. This study therefore attempts to identify and estimate the key determinants for supply of pharmaceuticals and non-pharmaceuticals in Kenya.

In Kenya, the level of pharmaceuticals and non- pharmaceuticals available in the government health facilities is quite below the optimal level. The root cause of this pathetic phenomenon is that supply for health inputs is quite below the optimal level in the sense that in most cases, patients are not provided with the prescribed health inputs (mainly drugs) in the public health facilities. This situation prompts the patients to finally buy the inputs from stockists due to the fact that the demand for health inputs is commonly above the supply due to undersupply of the inputs to these facilities (Kimalu, 2002). The factors influencing this phenomenon have

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<sup>4</sup> Occurrences, distribution and causes of diseases to humankind.



not been addressed. This implies that there is a need to identify and analyse the factors that influence the supply of pharmaceuticals and non-pharmaceuticals in public health facilities.

#### **1.4 Objectives of the Study**

The study examines the factors that lead to fluctuations in the quantity of pharmaceuticals and non-pharmaceuticals provided in the GOK health facilities in Kenya. The specific objectives are;

- 1) To identify the factors influencing the supply of pharmaceuticals and non-pharmaceuticals to Kenyan public health facilities.
- 2) To measure the extent to which these factors influence the supply of pharmaceuticals and non-pharmaceuticals to the public health facilities.
- 3) On the basis of the findings in (1) and (2), suggest policy recommendations that can improve supply of the pharmaceuticals and non-pharmaceuticals in Kenyan health sector particularly in procurement of pharmaceuticals and non-pharmaceuticals.

#### **1.5 Significance of the Study**

Most of the existing health-related studies such as Vogel (2002), Mwabu (1984), Powell (1997), Ngugi (1999) and Weaver (1997) have mainly focused on health seeking behaviours of individuals. They have not paid much attention to supply of pharmaceuticals and non-pharmaceuticals. Some studies related to supply of pharmaceuticals and non-pharmaceuticals have analysed other countries but not Kenya e.g. Rice, (2000) analysed U.S.A. while McGuire, (1988) and Zweifel, (1992) analysed the Great Britain. Others like Ahmed et al, 2003 analysed financing of health care through medical scheme in Kenya. This implies that one area that has not received much attention is the factors that influence the supply of pharmaceuticals and non-pharmaceuticals to the public health facilities in Kenya. An analysis

of supply of pharmaceuticals and non-pharmaceuticals by GOK is very vital since if the government does not supply the relevant inputs to its health facilities, then the medical services will automatically become inaccessible. This is because without the relevant and effective tools and other related resources (pharmaceuticals and non-pharmaceuticals), delivery of health services to the consumer expectation will fail. One way of improving the health care delivery in Kenya is considering the major determinants of supply of pharmaceuticals and non-pharmaceuticals.

This study will therefore shed light on the factors influencing the supply of pharmaceuticals and non-pharmaceuticals in Kenya. By identifying the major influencing factors, the findings of the study will assist policy makers in designing policies for the health sector especially in procurement and distribution of pharmaceuticals and non-pharmaceuticals.

Information on factors influencing supply of pharmaceuticals and non-pharmaceuticals will play a fundamental role in identifying the quantity that the MOH will procure for public health facilities in a particular year. The price of pharmaceutical or non-pharmaceutical products is just one of the determinants of their supply in Kenya. Others that also play quite a remarkable role but not accorded a lot of emphasis due to their non-monetary nature are technology, Gross Domestic Product (GDP) and population.

A reliable system of providing both pharmaceuticals and non-pharmaceuticals to the existing GOK hospitals, health centres and dispensaries is vital for ensuring that the methods to fight diseases would get upgraded. The outcome of this study will be a quality health care delivery where health sector will be able to improve its performance in delivery of health care services which is one of the goals that are fulfilled by the sector but not at a satisfactory level.

This study will thus move an extra mile as it will provide reference materials for studies related to supply of health inputs. The study also has likelihood for demonstrating the relationship between supply of pharmaceuticals and non-pharmaceuticals and the factors influencing their supply. This would help in filling the existing information gap.

## CHAPTER 2: LITERATURE REVIEW

### 2.1 Introduction

In this chapter, the literature on supply of pharmaceuticals and non-pharmaceuticals by the health sector to the public health facilities is reviewed. Both the theoretical and empirical literature are summarized.

### 2.2 Theoretical literature

In the health economics literature, the factors determining the supply of pharmaceuticals and non-pharmaceuticals have been analysed. According to Phelps (2002), health can be produced or at least restore part of it after an illness, by using what we call “medical care” a set of activities designed specifically to restore or augment the stock of health.

Demonstrating the effect of input unit prices on supply, Nicholson (1987), pointed out that the effect of an increase in an input unit price on supply of a commodity is an upward shift in the supply curve. Supply of pharmaceuticals and non-pharmaceuticals by MOH to the public health facilities follow this supply of commodity behavior. As pointed out by Frank (2004), a key feature of pharmaceutical industry is that, pharmaceutical products are manufactured at a cost which is reflected in the products market in form of the products’ prices. In the supply of pharmaceuticals and non-pharmaceuticals, their prices will represent the input unit prices. The prices of pharmaceuticals and non-pharmaceuticals thus represent the prices of inputs in supply of health care services. Coleman et al (2005) found that supply of medical supplies i.e both pharmaceuticals and non-pharmaceuticals depends on their prices.

In a simple equation form, we get:

$$Q_s = f(p_i) \dots \dots \dots (2.2.1)$$

Where; (i)  $Q_s$  represents quantity of pharmaceuticals and non-pharmaceuticals supplied by the government to the public health facilities.

(ii)  $P_i$  represents input unit prices in Kenya shillings.

Equation 2.2.1 implies that input unit prices are factors of quantity of pharmaceuticals and non-pharmaceuticals provided. Input unit price is therefore one of the factors determining the supply of pharmaceuticals and non-pharmaceuticals.

Since the MOH converts the inputs into outputs, the output is in this case taken as the quantity of pharmaceuticals and non-pharmaceuticals provided by the MOH to the public health facilities. It therefore follows that input unit prices are the production costs. Production costs thus affect production of health care by MOH. As established by American medical Association (2003), as production cost of health care rises, the quantity of health care produced falls. The same association noted that rising regulatory and production costs are disincentives to produce health services.

Further emphasizing on effect of input unit prices, Bruce et al (1978) noted that , in product supply function, the slope of supply functions does not increase (usually decreases) as constraints are added to the optimization problem where the constraints include input costs. These constraints lead to an under-supply situation of pharmaceuticals and non-pharmaceuticals in public health facilities. PHC (Primary health care) requires a continuous supply of essential drugs (Medawar, 1985). Studying the effect that production cost of health care impacts on supply of health inputs by the government, Bazeyo (2004) found that as production cost of health increases, supply of health inputs goes down.

On the basis of the above argument, input unit prices are a reflection of production cost. On an analysis of input unit prices on a supply curve, Mansfield (1983) put it that, the supply

curve for a commodity is affected by the input unit prices implying that when input unit prices increase, the amount of commodities produced decreases hence a reduction in the quantity supplied. Analyzing the effect of product price on supply of health services, McGuire, (1988) established that when user fee i.e. the product price rises, more health services are supplied in the public health facilities.

According to Mwabu, et al, (2004), one way of medical financing in Kenya has been service payment through user fee. The user fee is therefore taken as a proxy for product price where the product is the health service offered in health facilities. MOH will therefore provide pharmaceuticals and non-pharmaceuticals to public health facilities based on output price i.e. the charges of health services.

This leads us to the equation:

$$Q_s = f(P_p) \dots\dots\dots (2.2.2)$$

Where; (i)  $Q_s$  = Quantity of Pharmaceuticals and non-pharmaceuticals supplied by MOH.

(ii)  $P_p$  =Product price i.e. the user fee paid by health seeker in a public health facility.

This indicates that output price is one of the factors that determine the amount of pharmaceuticals and non-pharmaceuticals supplied by the government. Since these Pharmaceuticals and non-pharmaceuticals are converted into the health care services produced by MOH, equation (2.2.2) can be re-written as:

$$H_s =f(P_p) \dots\dots\dots (2.2.3)$$

Where: (i)  $H_s$  = Quantity of health services offered at the public health facilities.

(ii)  $P_p$  = the price of health service in Kenya shillings paid for the health service provided to the health sector.

Equations (2.2.2) and (2.2.3) imply that the price for a health service i.e. the product price is a factor for the quantity output of health services produced by MOH.

Supporting the above, Phelps (2002) further argued that higher prices of health services bring forth more production of such services. This means that when health care charges hike, the MOH supply for health services goes up also. This implies that, the MOH provides more units of pharmaceuticals and non-pharmaceuticals to the facilities when their prices go up. Rice (2000) asserted that product price is a factor that causes a supply curve to shift outwards where he referred the relationship between the quantity of a good supplied and its price as the elasticity of supply. This elasticity is defined as the change in the quantity of a good supplied, divided by the percentage change in its price. For instance, if supply elasticity is found to be +0.15, it implies that when the market price rises by, say, 10 percent, quantity supplied increases by 1.5 per cent. In this case, public health facilities are treated like commodity markets whereby health care is a commodity whereas every market is characterised by a supply side. Indeed, Mansfield (1983) framed it that the supply side of a market can be represented by a market supply curve that shows the amount of the commodity that seller would offer at various prices.

Another variable that has been confirmed to have effect on supply is technology. Rice (2000) found that technology affects production given that technological breakthrough reduces the cost of production. The author noted that technological advancement causes an increase in a supply. According to Folland et al (2001), technological change necessarily entails an improvement in production efficiency leading to providing new or improved products. Eventually, it will be less expensive to produce a given output, holding quality constant. It then follows that:

$$Q_s = f(T) \dots \dots \dots (2.2.4)$$

Where: (i)  $Q_s$  = is the quantity of pharmaceuticals and non-pharmaceuticals provided.

(ii)  $T$  = Technological progress applied in medical care.

In contrast to the above, Newhouse (1993) asserted that most analysts in the health services area find technology to be, on average, cost increasing rather than cost decreasing. If Newman's claim holds validity, then the technologies being used are probably designed not to reduce cost so much as to improve people's health status and/or comfort.

Planning for health human resources is based on the health needs of the population that requires to consider factors that affect use of health care services since higher populations use more health resources (Murphy et al, 2003). Kathuria et al, 2005 noted that there is scope for health systems to re-orient their strategies in order to provide the best health care in the most efficient way or at the lowest possible cost where health care is based on state's population. The increasing population is causing a rise in the numbers of clients/patients visiting the health facilities who have to compete with other patients for the same equipment e.g. laboratory equipment due to inadequacy of these medical equipment (Orach, 2005). Assessing the rural population needs for health care, Ruolz and Carr (2003) realized that as rural population grows, poverty looms which causes higher vulnerability. This situation results to higher morbidity prevalence that pushes the demand for health services upwards. In response to this, the government is expected to provide more health services hence supplying more health resources including pharmaceuticals and non-pharmaceuticals to the public health facilities.

In relation to the outlined connection between supply of pharmaceuticals and non-pharmaceuticals, we get the equation;

$$Q_s = f(PN) \dots \dots \dots (2.2.5)$$



Where: (i)  $Q_s$  = is the quantity of pharmaceuticals and non-pharmaceuticals provided.

(ii)  $PN$  = Population size in the country.

Equation 2.2.5 implies that population is one of the factors affecting the supply of pharmaceuticals and non-pharmaceuticals.

On an analysis of G.D.P's impact on the supply of health inputs by the Government, Kanavos and Mossialos (1996) conclusively found that GDP is an important determinant of the supply of health services through expenditures on healthcare. Abel-Smith (1967) too established that GDP after adjustment for inflation, exchange rates and population, is a major influencing factor of health inputs supply. Ruolz and Carr, (2003) noted that just like most of the major OECD countries, Canada has experienced a substantial increase in the proportion of GDP that it allocates to health expenditures. They emphasized that health services in Canada are chiefly financed by the public sector. However, the public sector's financial stability mainly depends on the country's GDP. In an equation form, the relationship between supply of the health inputs and GDP can be expressed as;

$$Q_s = f(GDP) \dots \dots \dots (2.2.6)$$

Where: (i)  $Q_s$  = is the quantity of pharmaceuticals and non-pharmaceuticals supplied.

(ii)  $GDP$  = The gross domestic country of the country.

This indicates that GDP also influences supply of pharmaceuticals and non-pharmaceuticals.

Combining the above equations, we now get;

$$Q_s = f(P_p, P_i, T, PN, GDP) \dots \dots \dots (2.2.7)$$

Where ; (i)  $Q_s$  = the quantity of pharmaceuticals and non-pharmaceuticals supplied.

(ii)  $P_p$  = the product price

(iii)  $P_i$  = the input unit price

(iv)  $T$  = Technology

(v)PN =Population

(vi)GDP =Gross Domestic Product.]

### 2.3 Empirical literature

To some extent, product price has been empirically examined and confirmed to be a key determinant of supply of pharmaceuticals and non-pharmaceuticals. Henderson and Cockburn (1996) and Danzon et al, (2003) studied the determinants of supply of pharmaceuticals and non-pharmaceuticals in health facilities. They mainly focused on price of the health care where user fee was used. They eventually overwhelmingly concluded that as prices of pharmaceuticals and non-pharmaceuticals, so does their supply. Grabowski and Vernon (1992) found that, the prices for pharmaceuticals and non-pharmaceuticals affect the magnitude for the supply of these health inputs. In 1988, Hurwitz and Caves examined whether pharmaceutical's or non-pharmaceutical's prices played any role in determining the quantity of pharmaceuticals and non-pharmaceuticals that are supplied. They established that just like any other normal good, the supply of pharmaceuticals and non-pharmaceuticals is a function of their prices. Huskamp et al, (2003) using a time-series analysis established that prices of pharmaceutical products greatly affect their supply.

Ruolz and Carr, (2003) established that Canada's GDP is highly significant to the country's supply of health services. They found that its health expenditures increased from \$351 in 1966 to \$1,464 in 1998 while on average, GDP growth rate was 4.5% between 1966 and 1998. These results prompted the researchers to conclude that GDP actually affects expenditure on health that reflects the supply of pharmaceuticals and non-pharmaceuticals. Gerdtham et al, (1988) used a cross section of 19 OECD countries and concluded that population affects expenditure on health. Jonsson, (2000) later tested the significance of GDP on quantity of pharmaceuticals and non-pharmaceuticals provided by the government. The

findings were that, in real sense, GDP is a very important determinant of supply of pharmaceuticals and non-pharmaceuticals. Their regression used time series data. Hitiris and Posnett (1992), by using a sample of 560 pooled time-series and cross-section observations, confirmed the importance of GDP as a determinant of health spending. According to the centre for Medicare and medical services (2004), U.S.A's expenditure on health services rose remarkably between 1960 -1993. At the same period, G.D.P also rose quite substantially, an indication that the supply of pharmaceuticals and non-pharmaceuticals .As country's population grows, expenditure on health inputs increases (Di Matteu and Di Matteu, 1998). Gerdtham et al (1988) analyzed nineteen countries and found that population affects expenditure on health mainly the supply of pharmaceuticals and non-pharmaceuticals.

Supply of pharmaceuticals and non-pharmaceuticals is also affected by technological change (Weisbrod, 1999). He concluded that technology contributes positively to the expenditure on health hence the quantity of pharmaceuticals and non-pharmaceuticals supplied/provided. Kremar, (2002) provided evidence that technological advancement would lead to a market expansion reflecting an upward shift in the supply curve of pharmaceuticals and non-pharmaceuticals. Reifn and Ward, (2002) established that technological advancement leads to new markets of pharmaceuticals and non-pharmaceuticals. They realized that technological advancement triggers innovation of new products e.g. generic drugs.<sup>5</sup> This creates new markets or expanding the already existing markets of pharmaceuticals and non-pharmaceuticals implying an increment in supply of health services. Similar studies by Kennedy (1964), ( Drandkis and Phelps (1965), Samuelson (1965), Hayami and Rutten, (1970) and Acemoglu, (1998) found that discoveries of new drugs due to an improved technology increases the supply of pharmaceuticals and non-pharmaceuticals.

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<sup>5</sup> Generic drugs are discovered/innovated as a result of technological advancement.

Ling et al, (2003) investigated the complementarities between technology and supply of health inputs. In this investigation they took the skills of physicians as the proxy of technology. They found that technological progress in the pharmaceutical industry has caused a rise in supply of pharmaceutical products.

## **2.4 Overview of the literature**

Factors that affect supply of pharmaceuticals and non-pharmaceuticals are the supply factors. In many cases, MOH fails to meet sufficient demand for pharmaceuticals and non-pharmaceuticals hence either under-supplying or oversupplying the inputs (WHO, 1999). This problem is mainly caused by lack of considering the key factors that influence supply of pharmaceuticals and non-pharmaceuticals. Optimal level of inputs supplied by MOH to the public health facilities would be achieved if these influencing factors were taken into consideration.

In the light of both the theoretical and empirical literature, several variables are captured as the determining factors of supply of pharmaceuticals and non-pharmaceuticals. These factors seem to be showing a lot of similarities in the sense that they all affect the supply of pharmaceuticals and non-pharmaceuticals. However, it is important to note that supply or supply of pharmaceuticals and non-pharmaceuticals by the Government to the public health facilities has not been researched on extensively since most studies have dwelt on health seeking behavior whereas the fact is pharmaceuticals and non-pharmaceuticals in a given health facility really affect the quality of health care provided in particular facility. In view of the literature that has been used as a reference of this paper, the factors that influence the supply of pharmaceuticals and non-pharmaceuticals in Kenyan public health facilities are; prices/charges of the health services, unit prices of the pharmaceuticals and non-pharmaceuticals, technological change, GDP and the population.

**3.1: Introduction**

This chapter begins with a model specification that will be used to do the empirical estimation on the factors that influence supply of pharmaceuticals and non-pharmaceuticals in Kenya. Hypotheses is presented, then the explanation plus definition of variables; both the dependent and independent. Measurement of these variables is then explained. There is also the research data type and source. At the end of the chapter, there is the stationarity and multicollinearity meant for data refinement.

**3.2 Model specification**

The study attempts to investigate the determinants of supply of pharmaceuticals and non-pharmaceuticals in Kenya. The factors which affect the supply of these medical supplies will be included under the model specification. The general model to be empirically tested will thus be:

$$Q_s = f(P_p, P_i, GD, PN) \dots\dots\dots (3.2.1)$$

Where:-

- Q<sub>s</sub> = The quantity of both pharmaceuticals and non-pharmaceuticals supplied to the public health facilities.
- P<sub>p</sub> = Product prices i.e. the price of the health care services
- P<sub>i</sub> = Input unit prices i.e. the price of pharmaceuticals and non-pharmaceuticals.
- GD = Gross Domestic Product acting as proxy for economic growth
- PN = Population

In this case, I assume a Cobb Douglas supply function expressed as:

$$Q_s = \alpha P_p^{\beta_1} P_i^{\beta_2} G D^{\beta_3} P N^{\beta_4} \dots\dots\dots (3.2.2)$$

Where  $\alpha$  represents a technological coefficient while  $\beta_i$  represents elasticities of the regressors.

### 3.3 Estimation procedure

The equation to be estimated is a log log regression model specified in equation 3.3.1. The study will use Ordinary Least Squares (OLS) to estimate a log-linear form of the equation (3.3.1). According to Koutsoyiannis (2003), OLS method is preferred because;

- (i) It has essential components of most other econometrics techniques. Examples of these components are estimators like Generalized Least Square Estimator (GSLE) and the Maximum Likelihood Estimator (MLE) due to elasticities associated with the independent variables.
- (ii) It is used in a wide range of economic relationships with fairly satisfactory results e.g. the relationship between a dependent variable and the regressors.
- (iii) The data sample size required must not be too big.

A log-linear form of the equation will enable the researcher to interpret regression coefficients as elasticities. Log linear transformation is convenient because of its simplicity and easy interpretation since it is associated with direct estimates of elasticities (Johnston and DiNardo, 1997 and Maddalla, 2002). Green (1997), advocated for the use of log linear transformation in models for both demand and production estimation. The specific equation to be estimated is a linear and additive of the function form:-

$$\text{Log } Q_s = \alpha + \beta_1 \text{ Log } P_p + \beta_2 \text{ Log } P_i + \beta_3 \text{ Log } G D + \beta_4 \text{ Log } P N + e \dots\dots\dots (3.3.1)$$

Where;

Log $Q_s$	=	Logarithm of quantity of pharmaceuticals and non-pharmaceuticals supplied to the public health facilities by the Government.
Log $P_p$	=	Logarithm of product prices i.e. user fee charged in public health facilities.
Log $P_i$	=	Logarithm of input unit prices i.e. the inputs used to produce the health services.
Log $GD$	=	Logarithm of gross domestic product
Log $PN$	=	Logarithm of population size
$\alpha$	=	Technological coefficient
$e$	=	The error term
$\beta_i$	=	Elasticities to be estimated for the respective explanatory variables

**Expected signs**

The estimated parameters ( $\beta_1, \beta_2 \dots\dots\dots, \beta_4$ ) are expected to have the following signs:

$\beta_1 > 0$  (positive) because if user fee charged by health public facilities increases, the quantity of health services to be supplied/provided will increase hence an increase in supply of pharmaceuticals and non-pharmaceuticals.

$\beta_2 > 0$  (negative) because if input unit prices rise, production cost of health services increases. When production cost rises, quantity of health services produced will be less hence a reduction in the quantity of health services produced. This reduction will lead to a reduction in the quantity of pharmaceuticals and non-pharmaceuticals supplied.

$\beta_3 > 0$  (positive) because if GDP rises, the quantity of pharmaceuticals and non-pharmaceuticals to be supplied/provided to the public health facilities

will increase also. This is because when GDP rises, the government will be more economically stable hence more likely to allocate more funds to MOH for procuring more health inputs.

$\beta_4 > 0$  (positive)

because if population size increases (especially in the developing countries), poverty increases that makes vulnerability to rise. Morbidity prevalence rises in turn which makes demand for health care to rise. This rise in demand will cause a rise in supply of the health services hence a rise in the quantity of pharmaceuticals and non-pharmaceuticals supplied by the government.

### 3.4 Null hypotheses

The study will test the hypothesis that;

(i) The user fee charged in the public health facilities does not influence the supply of pharmaceuticals and non-pharmaceuticals to the government health facilities in Kenya.

( $H_0: \beta_1 = 0$  or  $H_1 : \beta_1 \neq 0$ )

(ii) The input unit prices do not influence the supply of pharmaceuticals and non-pharmaceuticals.

( $H_0: \beta_2 = 0$  or  $H_1 : \beta_2 \neq 0$ )

(iii) GDP does not influence the supply of pharmaceuticals and non-pharmaceuticals

( $H_0: \beta_3 = 0$  or  $H_1 : \beta_3 \neq 0$ )

(iv) The population size does not influence the supply of health inputs.

( $H_0: \beta_4 = 0$  or  $H_1 : \beta_4 \neq 0$ )



### **3.5 Definition and measurement of variables**

#### ***(i) Supply ( $Q_s$ )***

This refers to the quantity of pharmaceuticals and non-pharmaceuticals provided to the government health facilities by MOH. This will be measured as the total expenditure in thousands Kenyan shillings on purchases of pharmaceuticals and non-pharmaceuticals. The amount of total expenditure in Kenyan shillings will be taken as proxy for the quantity of pharmaceuticals and non-pharmaceuticals supplied in a year.

#### ***(ii) Product price ( $P_p$ )***

Product price refers to the charges in Kenya shillings charged by government health facilities in a particular year. This will be measured as the user fee charged to health care seekers in the government health facilities.

#### ***(iii) Input unit price ( $P_i$ )***

Input unit price refers to the unit cost of pharmaceutical and non-pharmaceutical products provided to the government health facilities which are used by the health care providers.

#### ***(iv) Gross Domestic Product ( $GD$ )***

This will be used as a measure of economic performance of the country in a particular year hence a proxy of economic growth.

#### ***(v) Population ( $PN$ )***

Population refers to the total number of people in a particular year. This will be measured as the population sizes in a country which is assumed to have a positive relationship with the total number of patients who sought medical care from a government health facility.

### **3.6 Research data type and sources**

This study will make use of descriptive and econometric analysis that will make an attempt to examine the principal factors influencing supply of health inputs in Kenya. There will be illustrations to depict how the captured determinants have been varying over time. For simplicity purposes, these illustrations will be done by use of graphs and tables. This analysis will use time series data for the period 1970 to 2004 comprising 35 (thirty five) years. Various publications which will be the key sources of data are: -

- Economic surveys
- Statistical abstracts
- National development plans
- Health management information systems reports

Other proposed sources include:

- World Bank Publications
- Kenya Demographic and Health Surveys (KDHS)

### **3.7 Limitation of the study**

The most outstanding limitation is the availability of relevant data and its quality due to approximations and use of proxies for some variables. The fact that only the secondary data will be used poses a constraint also.

### **3.8 Data refinement and analysis**

#### **3.8.1 Multicollinearity**

Possibilities that some independent variables in the model may be highly correlated with each other cannot be ruled out. These possibilities prompt a need to test for the presence of high collinearity among the regressors. There is no specific measure of multicollinearity but there

are some rule of thumbs or indicators that be applied to test if there evidence of presence of multicollinearity(Gujarati,2003). Some indicators include;

- (i) Wider confidence intervals due to large standard errors.
- (ii) High R<sup>2</sup> but few significant values
- (iii) Wrong signs for regression estimates

Mukras (1993) established that no two explanatory variables should be strongly correlated with each other. Although it is inherent that some amount of collinearity should be expected between economic variables, what is not tolerated is a strong collinearity between the explanatory variables of the model.

### 3.8.2 Data Stationarity

In the event of estimating the equation, presence of non-stationarity condition may be detected. For this reason, there is a need to test whether each of the explanatory variables is non-stationary. Testing this will require performing a unit root test on each of the variables. Alternatively, order of integration of each series may be tested as a device to test non-stationarity condition.

Either of the following test will be used to testing for non-stationarity :

- (i) The Dickey Fuller (DF) test.

$$\Delta Y_t = \alpha + \beta_t + \delta Y_{t-1} + \epsilon_t \dots\dots\dots (3.8.2.1)$$

$$H_0: \delta = 0 \{ Y_{t-1} (1) \}$$

$$H_1: \delta < 0 \{ Y_{t-1} (0) \}$$

Where:

$\Delta Y_t$  represents the variable we are testing in time t.

$Y_{t-1}$  represents lagging the variable being tested once.

$\epsilon_t$  represents white noise error term. i.e. a variable which is independently and

Identically distributed as normal distribution with zero mean and constant variance.

(ii) The Augmented Dickey Fuller (ADF) test

$$\Delta Y_t = \alpha + \beta_t + \delta Y_{t-1} + \sum_{i=1}^n K_i \Delta Y_{t-i} + \epsilon_t \dots\dots\dots (3.8.2.2)$$

This test is characterised by a Log that indicates the spread which is required for an explanatory variable to exhaust the explanatory effect/influence on the dependent variable. K represents the number of augmentations necessary to rid the series from autocorrelation.

The aim of the test is null hypotheses such that  $\delta = 0$  where  $Y_t$  has a unit root if  $\delta = 0$ .

### 3.8.3 Cointegration tests

Engel Granger (1987) came up with a cointegrating regression that is specified as:

$$Y_t = \alpha_0 + \alpha_1 \psi_t + \epsilon_t \dots\dots\dots (3.8.3.1)$$

Cointegration test will be performed should non-stationarity be detected in the equation. In this case, ADF test will be applied to the residual of statistic cointegrating (Long run) regression instead of the levels of the series.

From equation (3.8.3.1), the residual of the equation  $\epsilon_t = (Y_t - \alpha_0 - \alpha_1 \psi_t)$  is the linear difference of the 1(1) series. Engel and Granger (1987), too established that when residuals from the linear combination of non-stationarity series are themselves stationary, it then follows that the 1(1) are cointegrated and the residuals from the cointegrating regression are taken as valid Error Correction Mechanism (ECM) whereby when testing for cointegration, the critical values for the tests will differ according to the number of variables in the cointegrating regression.

## CHAPTER FOUR: DATA ANALYSIS AND RESULTS

### 4.1: Introduction

This chapter is meant to statistically describe the variables used in the regression model. Such descriptive statistics will require doing the estimation result analysis. The results to be analysed are found after estimating the empirical equation using the OLS method explained earlier in chapter three. Result analysis will involve performing several tests that will be; normality test, stationarity test and cointegration test.

### 4.2 DESCRIPTIVE STATISTICS OF THE VARIABLES USED

Table 4.2.1

	QSP	PRP	PN	PI	GD
Mean	2.07E+09	37.94118	21358233	35.16348	5.35E+10
Median	1.39E+09	20.00000	20763250	14.52585	6.48E+10
Maximum	6.07E+09	150.0000	31639091	118.3950	8.03E+10
Minimum	7183000.	10.00000	11370100	2.344100	9.52E+09
Std. Dev.	1.99E+09	47.91276	6697203.	38.07724	2.53E+10
Skewness	0.761428	1.875669	0.049314	0.927405	-0.597470
Kurtosis	2.128014	4.722350	1.584175	2.306676	1.697584
Jarque-Bera Probability	4.362559 0.112897	24.13862 0.000006	2.853573 0.240079	5.554778 0.062201	4.425908 0.109377
Observations	34	34	34	34	34

Where;

QSP=Quantity of pharmaceuticals and non-pharmaceuticals supplied by the government to the public health facilities.

PRP = The price of health care or health services in Kenya shillings.

PN = The country's population

PI =The price of inputs

GD =The Gross Domestic Product.

### 4.3 Normality test

This is done to test normality for the variables used. It tests whether variables to be used in estimation model are normally distributed. The test is based on the null hypothesis of normality against the alternative hypothesis of non-normality. This test uses the Jarque Bera (JB) chi square test for normality based on the probabilities. The Chi-Square test (Snedecor and Cochran, 1989) is used to test if a sample data was extracted from a population with a specific distribution. If the probability value is less than the JB chi square statistics, then we do not reject the null hypothesis of normality and hence accept that the variables are normally distributed. If the probability value is greater than the JB chi square statistics, then we reject the null hypothesis of normality and hence the variables are not normally distributed. Normality test performed produced the results as summarized in table 4.2.2 below.

**Table 4.2.2 Normality test results**

	LNGD	LNPI	LNPN	LNPRP	LNQSP
Mean	24.52457	2.842674	16.82573	3.134344	20.66036
Median	24.89472	2.675072	16.84861	2.995732	21.05435
Maximum	25.10935	4.774026	17.26990	5.010635	22.52616
Minimum	22.97703	0.851902	16.24650	2.302585	15.78723
Std. Dev.	0.689122	1.302822	0.331091	0.910734	1.663021
Skewness	-1.045024	0.047284	-0.245201	1.046426	-1.152730
Kurtosis	2.672920	1.663197	1.692596	3.096816	4.013671
Jarque-Bera Probability	6.339979 0.042004	2.544313 0.280227	2.762218 0.251300	6.218321 0.044638	8.985461 0.011190
Observations	34	34	34	34	34

From table 4.2.2, all the variables used are normally distributed. Normality condition holds if JB value exceeds the probability value. This therefore implies that:

- i. The quantity supplied which is the dependent variable has the highest degree of normality than any other variable since its probability value (0.011190) is far much below its JB value of 8.985461.
- ii. Input unit price is also normally distributed since its JB value which is 2.5443132 is greater than its probability value whose value is 0.280227.
- iii. The population (PN) is also normally distributed given that its JB value is larger than its probability value i.e.  $2.762218 > 0.251300$ .

- iv. The product price (PRP) is normally distributed because its JB value is larger than its probability value i.e.  $5.302707 > 0.070556$ .
- v. The quantity supplied (QSP) is also normally distributed since its JB value is greater than its probability value where  $8.985461 > 0.011190$ .

#### 4.4 Data stationarity test

A stationary process has the property that the mean, variance and autocorrelation structure do not change over time. If stationary, the variable does not have a trend. Time series analysis makes sense if the variables are stationary. It then follows that the first task is to make sure that the data is stationary. This is because the time series data is known to be non-stationary in most of the cases.

Due to the above concern, precaution measures were taken by checking any degree of non-stationarity. It was detected that all the variables used are non-stationary as shown by the graphs in Appendix 1. Having detected non-stationarity in the data, there was a need to make these variables stationary. If data is not stationary, one alternative is to switch to differencing to make it stationary. All stationary variables are integrated of order 0 (zero).

Differencing technique is applied by creating new series as:

Given the series  $QSP_t$ , we create the new series such that:

$$DQSP_t = QSP_t - QSP_{t-1}$$

where now the differenced data will contain one less point than the original data.

After differencing the variables, the results in form of graphs are as shown in appendix 2.

#### 4.5 Unit root test

Unit root test is performed in the first stage to test for stationarity in the variables. The most commonly used tests are DF (Dickey Fuller) and ADF (Augmented Dickey Fuller). Both the DF and ADF tests are used to detect unit roots in time series data (Dickey and Fuller, 1970).

#### 4.5.1 The DF (Dickey Fuller) test.

This is an autoregressive (AR) model, which is a random walk without a drift. This model is specified as AR (1). It is based on the equation  $Y_t = \alpha Y_{t-1} + \epsilon_t$  ..... 2

Where;  $\alpha$  is the coefficient value of the variable in the previous period.

A .The null hypothesis of non stationarity against the alternative hypothesis of stationarity is used as follows;

$H_0: \alpha > 0$                       Non Stationarity condition

$H_1: \alpha < 1$                       Stationarity condition

If the null hypothesis is rejected, then non-stationarity condition is ruled out and we draw the inference that the series is stationary. If the null hypothesis is accepted, then the non-stationarity condition holds hence the series is non -stationary.

The t-statistics is then compared with t-critical and if the t -statistics is less than the t-critical, we reject the null hypothesis implying that the series is stationary.

#### 4.5.2 The Augmented Dickey Fuller (ADF) test

Granger and Engle (1987) performed the ADF test and verified its reliability in detection of unit root condition. It follows the same procedure as the DF. ADF differs from DF in that the former is applied in the random walk model with a drift or an intercept whereas the latter is in the random walk without a drift. This implies that ADF takes care of the intercept unlike DF which does not. Based on the ADF's advantage cited above, it is preferred to DF in most circumstances. The test is demonstrated in the equation below;

$$Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \epsilon_t \dots\dots\dots 3$$

Where;

$\alpha_0$  is the drift or intercept of trend.

Equating equations (2) and (3) yield ;



$$Y_t = \alpha_0 + (\alpha_{1-1})Y_{t-1} + \epsilon_t$$

By letting  $\alpha_{1-1} = \delta$ , we now form a null hypothesis.

The t-statistics is then compared with t-critical and if the t statistics is less than the t-critical, we reject the null hypothesis and conclude that the series is stationary

The variables at their levels are non-stationary as indicated in the table below

**Table 4.5.1 ADF unit root test**

VARIABLE	ADF STATISTIC	5% CRITICAL VALUE	NATURE
LNGD	-1.275224	-3.5514	NON-STATIONARY
LNPI	-1.316474	-3.5514	NON-STATIONARY
LNPN	-1.025832	-3.5514	NON-STATIONARY
LNPRP	-2.227146	-3.5514	NON-STATIONARY
LNQSP	-8.394684	-3.5514	NON-STATIONARY

As depicted in table 4.5.1, all the variables are confirmed non-stationary because the ADF t-Statistic is greater the ADF t-critical. E.g. for LNGD, its t-statistic (-1.275224) is greater than its t-critical (-3.5514).

**Table 4.5.2 Unit Root results after Differencing**

VARIABLE	ADF T-STATISTICS	5 % CRITICAL VALUE	NATURE
LNGD	-6.706735	-3.5562	STATIONARY
LNPI	-5.710651	-3.5614	STATIONARY
LNPN	-7.381555	-3.5562	STATIONARY
LNPRP	-6.036599	-3.5562	STATIONARY
LNQSP	-11.06123	-3.5614	STATIONARY

From table 4.5.2, all the variables are stationary after differencing them once and hence integrated of order 1 i.e. I(1). This is evidenced by the fact that all their ADF T-statistics values are less than their ADF T-criticals. For instance, the T-statistic for LNPI has been computed as -5.710651 is less than its T-critical (-3.5614).

#### 4.6 Cointegrating analysis

This is done to test the long run relationship among the variables. This test is done using the unit root test. The existence of cointegration is important because failure to find it may be a manifestation of the spurious regression. The commonly used test for cointegration is the Engle –Granger cointegration done on the residuals.

TABLE 4.6.1: cointegration test results on RESDLNQSP

ADF Test Statistic	-11.11078	1% Critical Value*	-4.2826
		5% Critical Value	-3.5614
		10% Critical Value	-3.2138

Where;

RESDLNQSP is the residual of the dependent variable (QSP)

From Table 4.6.1, it shows that the residual is stationary and hence the cointegration condition is fulfilled. This result indicates that an error correction model (ECM) is a better fit than the one without.

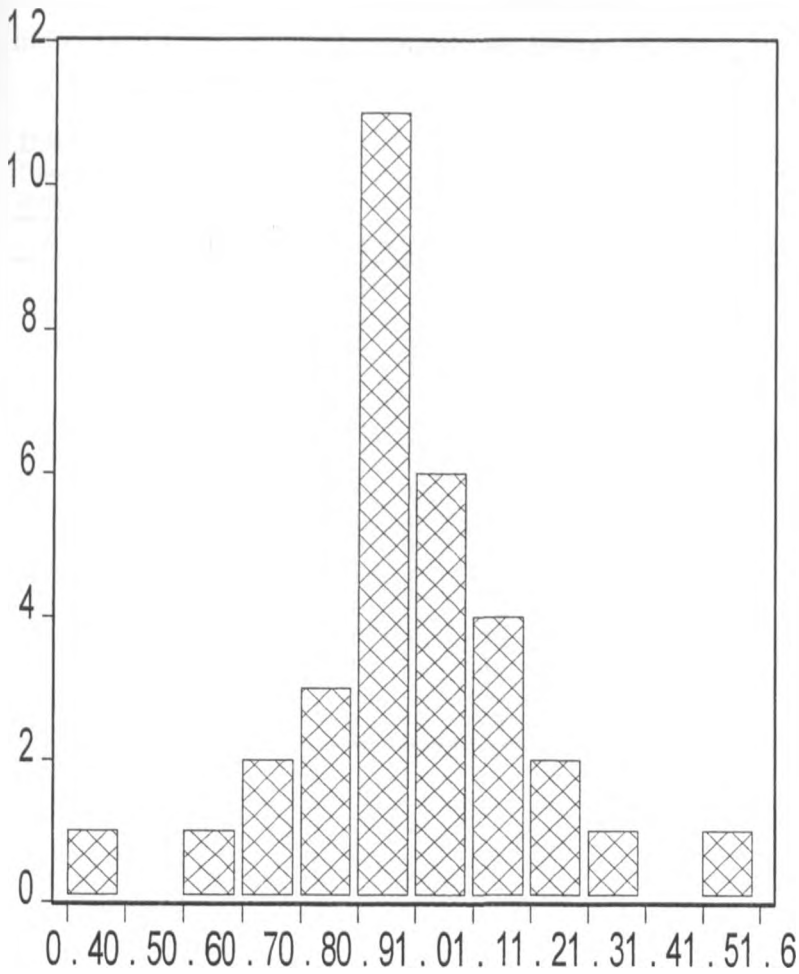
## **4.7 DIAGNOSTIC TESTS**

These tests are meant to show whether the models in use are consistent or not. The tests include;

### **4.7.1 Jarque Bera (JB) test**

The test is done to determine the distribution of the error term. For consistent estimation using the Ordinary Least Squares (OLS) method, the error term must be normally distributed. The JB uses the chi square distribution and the probability values. If the probability values are less than the JB chi square distribution, the residuals are normally distributed. JB basically concentrates on the distribution of the four moments (mean, standard deviation, skewness and kurtosis) of the series.

**Table 4.7.2 JB test on RESDLNQSP**



Series: RES  
 Sample 1972 2003  
 Observations 32

Mean 1.000000  
 Median 0.989357  
 Maximum 1.532658  
 Minimum 0.413597  
 Std. Dev. 0.199490  
 Skewness -0.199047  
 Kurtosis 4.889863

Jarque-Bera 4.973415  
 Probability 0.083183

	RES
Mean	1.000000
Median	0.989357
Maximum	1.532658
Minimum	0.413597
Std. Dev.	0.199490
Skewness	-0.199047
Kurtosis	4.889863
Jarque-Bera	4.973415
Probability	0.083183
Observations	32

From table 4.7.2, p value is less than JB chi square distribution since  $4.973415 < 0.083183$  implying that the residual is normally distributed.

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## Autocorrelation Test

This is a test for serial correlation because the DW test is not adequate especially when there are higher lags. The study uses correlogram method to test for serial autocorrelation. Since most of the stars are within the bands, we can say that there is minimal autocorrelation.

Date: 09/30/05 Time: 13:12

Sample: 1970 2003

Included observations: 32

Autocorrelation	Partial Correlation	AC	PAC	Q-Stat	Prob	
****  .	****  .	1	-0.489	-0.489	8.4039	0.004
.  **  .	.   .	2	0.272	0.043	11.095	0.004
. *  .	.   .	3	-0.157	-0.011	12.022	0.007
.  *  .	.   .	4	0.095	0.008	12.376	0.015
. *  .	.   .	5	-0.084	-0.036	12.659	0.027
.  *  .	.  *  .	6	0.120	0.080	13.257	0.039
. **  .	. **  .	7	-0.247	-0.200	15.904	0.026
.  **  .	.   .	8	0.213	0.007	17.957	0.022
. *  .	.   .	9	-0.184	-0.034	19.551	0.021
.  **  .	.  *  .	10	0.206	0.101	21.643	0.017
. **  .	.  *  .	11	-0.224	-0.099	24.250	0.012
.  *  .	.   .	12	0.180	0.014	26.008	0.011
. *  .	.  *  .	13	-0.086	0.069	26.435	0.015
.  *  .	.   .	14	0.070	-0.014	26.729	0.021
. *  .	.   .	15	-0.083	-0.034	27.167	0.027
.   .	.   .	16	0.042	-0.049	27.287	0.038

#### 4.8 \R\egression results

The model makes use of Autoregressive Distributed Lag (ADL) (1,1) meaning that both the dependent and independent variables are lagged once. It is an error correction model (ECM).

The results are as shown here below;

#### REGRESSION RESULTS

Dependent Variable: DDLNQSP

Method: Least Squares

Date: 10/11/05 Time: 12:22

Sample(adjusted): 1973 2003

Included observations: 31 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DDLNQSP_1	-0.024441	0.031756	0.769639	0.4505
DLNPN_1	0.142246	0.197178	-0.721408	0.4790
C	-0.024067	0.014763	-1.630231	0.1187
DLNPRP	0.021064	0.017314	1.216536	0.2379
RESDDLNQSP	1.009362	0.033502	30.12817	0.0000
DLNGD	0.008526	0.032902	0.259146	0.7982
DLNPI	-0.056639	0.085123	0.665384	0.5134
DLNGD_1	-0.071100	0.032894	-2.161453	0.0430
DLNPI_1	0.077586	0.085070	0.912020	0.3726
DLNPN	0.370646	0.198092	-1.871079	0.0460
DLNPRP_1	0.025732	0.017446	1.475003	0.1558
R-squared	0.985722	Mean dependent var	-0.034614	
Adjusted R-squared	0.978583	S.D. dependent var	0.194974	
S.E. of regression	0.028533	Akaike info criterion	-4.004069	
Sum squared resid	0.016283	Schwarz criterion	-3.495234	
Log likelihood	73.06306	F-statistic	138.0784	
Durbin-Watson stat	1.960524	Prob(F-statistic)	0.000000	

The  $R^2 = 0.985722$  meaning that the model has an explanatory power of about 98 % that has the implication that 98% of variations in quantity of health inputs provided to the public health facilities by MOH are explained in the model. This implies that the explanatory variables greatly influence supply of health inputs. The Durbin Watson is 1.960524 which is definitely closer to 2. This is an indication that the serial correlation of the residuals is absent. Since  $R^2$  is less than DURBIN WATSON where  $0.985722 < 1.960524$ , then spurious regression is not suspected. The probability of F-statistics is 0.000000 which is below 0.05 hence on average, all the variables are statistically significant.

### 1. DDLNQSP\_1

The previous quantity supplied (DDLNQSP\_1) determines the current quantity supplied (DDLNQSP) negatively i.e. there exists a negative relationship between the two variables as the explanatory variable has a negative sign. As the DDLNQSP\_1 increases by 1 unit, the current quantity supplied decreases by 0.024441 units. However, the probability value shows that it is statistically not significant since the p-value is greater than the 0.05 rule of thumb at 5 % level of confidence. The negative relationship between the two variables indicates that, as the quantity of pharmaceuticals and non-pharmaceuticals procured increases, the quantity to be procured the following year decreases and vice versa. The lagged variable represents the quantity bought or procured in the previous year whereby the last year's quantity may not be fully provided to the health facilities hence getting carried forward to be issued the next year. This quantity that remains unused by the end of the year is basically the balance in stock which affects the quantity to be bought in the current year. As the MOH plans to procure health inputs, it considers the balance in stock where the quantity required is procured being less by the current balance in stock i.e. the physical balance brought forward.

### 2. DLNPN- 1

This represents the lagged differenced logarithm of population. The variable is differenced once and lagged once also. It has a positive sign as expected in the hypothesis with a coefficient size of 0.142246 which implies that as population size increases, the quantity of pharmaceuticals and non-pharmaceuticals also increases. The coefficient size of 0.142246 indicates that if the population size increases by 1 (one) person, the quantity of the health inputs provided to the health facilities by government rises by 0.142246 units.

However, population size is not statistically significant based on the evidence that its t-statistic or the t-calculated is below the t-critical i.e  $-0.721408 < 1.96$ . The variable's insignificance is also proven by the fact that its probability value of 0.4790 is above 0.05 hence statically insignificant at 5% level of significance.

### 3. DLNPRP

This represents the differenced logarithm of product price i.e. the price of the health care. It is differenced once. Checking on the sign, it is positive as it was expected in the null hypothesis.

Positiveness interprets that both the dependent and independent variables follow the same direction such that when healthcare price rises, the MOH in response increases the quantity of pharmaceuticals and non-pharmaceuticals that it provides to the health facilities while if the price drops, the MOH reduces this quantity. The explanatory variable's coefficient is 0.021064 a depiction that when product price rises by 1(one) unit, the MOH increases the Quantity to provide to the health facilities by 0.021064 units. Judging its significance, there is a clear evidence that the variable is statistically insignificant as its t-statistic is less than t-critical where  $1.216536 < 1.96$ . Citing the significance argument on probability approach, the regressor is also insignificant since its probability value of 0.2379 is greater than 0.05. i.e.  $0.2379 > 0.05$  hence statistically insignificant at 5% level of significance.

#### **4. DLNGD**

DLNGD stands for the differenced logarithm of gross domestic product. The variable is differenced just once. Its sign is positive as expected hence positively correlated with the dependent variable i.e. QSP. The positive relationship indicates that as gross domestic product increases, so the quantity of pharmaceuticals and non-pharmaceuticals procured to be provided to the health facilities does in return. The size of the dependent variable's coefficient which is 0.008526 implies that if gross domestic product increases by 1(one) unit i.e. 1 thousand K£, the quantity provided by the ministry to health facilities increases by 0.008526 units whose monetary value is 0.008526 thousand Kenya pounds (K£). Gross domestic product is however statistically insignificant given the fact that its t-statistics or the t-calculated is less than the t-critical (1.96) i.e.  $0.259146 < 1.96$  implying insignificance. The probability value (0.7982) is greater than 0.05 reflecting a statistical insignificance at 5% level of significance.

#### **5. DLNPI**

In this study, this represents a differenced logarithm of input unit prices having been differenced once only. As expected, its sign is negative bringing the interpretation that this exogenous variable is negatively related to the endogenous variable. Being negatively related



implies that when input unit price rises, the quantity of pharmaceuticals and non-pharmaceuticals provided by MOH to health facilities decreases and vice versa. The exogenous variable's coefficient is 0.056639 which explains the extent to which this regressor affects the dependent variable such that if input unit prices for health services in Kenya rises by 1(one) unit i.e. one extra shilling, the MOH responds by reducing the medical supplies to be provided to health facilities by 0.056639 units which is equivalent to 0.056639 Kenya shillings expenditure by MOH on the health inputs. Input unit prices have been found to be statistically insignificant as its t-statistics (0.665384) is less than t-critical (1.96). i.e.  $0.665384 < 1.96$  hence not statistically significant. Insignificance is also shown by checking the 5% confidence level whereby this variables' probability value is 0.5134 which is above 0.05 hence statistically insignificant at 5% level of significance.

#### **4.9 Discussion of the results**

The equation estimated consisted of one dependent variable and four independent variables plus one error term (the residual). The dependent/endogenous variable was the quantity of pharmaceuticals and non-pharmaceuticals while the four exogenous variables are:-

- (i) Product price
- (ii) Input unit prices
- (iii) Population  
and
- (iv) Gross Domestic Product.

The data used in regression was annual time series data ranging from 1970 to 2004 covering a period of 35 years. This means that the sample size is 35. The focus of the econometric analysis was on the importance of the said explanatory variables on the supply of pharmaceuticals and non-pharmaceuticals to the public health facilities by the MOH in

Kenya. The analysis thus aimed at showing the variation effect of these variables on the quantity of these health inputs supplied by the government to the public health facilities. A log-log specification to estimate various variables' effect on the health inputs' quantity was used. The coefficients of the double-log model specification reflect elasticities of the exogenous variables in the model.

The results indicate that product price affects quantity of pharmaceuticals and non-pharmaceuticals supplied by the government to the public health facilities positively. This can perhaps be attributed to the fact that the government operates at some budget constraints where one solution to these constraints was to introduce cost-sharing. This cost-sharing is one way of income generation to the government. The government would therefore tend to supply commodities/services to the market when the price goes high in order to realize higher monetary returns. Generally, producers produce more commodities when the commodity's selling price is high, an approach that the government has seemed to apply. For the government to produce more health services, it has to procure more pharmaceuticals and non-pharmaceuticals which in return are supplied to the public health facilities.

Based on the estimation results, input unit price elasticity was found to be negatively related to the quantity of pharmaceuticals and non-pharmaceuticals supplied by MOH to public health facilities. In this case, input unit price reflects the production cost that the government undergoes when providing health care services to its citizens. The input unit price is basically the price at which both pharmaceuticals and non-pharmaceuticals are procured by MOH. When prices of these items go up the MOH become more constrained in procuring them hence negatively affecting the quantities it procures to be supplied to the public facilities. It then depicts that, the higher the input unit prices, the less quantity of pharmaceuticals and non-pharmaceuticals supplied by MOH.

The other explanatory variable which is the population has emerged to have a positive impact on the quantities of pharmaceuticals and non-pharmaceuticals procured by the government as it had been hypothesized. The positive correlation between the two would be attributed to the fact that high populations in underdeveloped countries like Kenya may lead to high morbidity. In an undeveloped country, a rise in population is highly likely to result to high incidences of poverty. Poverty causes higher vulnerability of diseases hence higher morbidity. When morbidity increases, health care seeking increases where demand for health care services goes up. The government is expected to react to this behaviour by supplying more health services that can be to some extent fulfilled by supplying more quantities of pharmaceuticals and non-pharmaceuticals to the public health facilities.

The Kenyan Gross Domestic Product (GDP) has been found to be positively related to the quantities of pharmaceuticals and non-pharmaceuticals procured by the ministry. A country's GDP is one of the indicators of the economic stability. It then follows that if a given year's GDP is high, the country's economic performance is better in that particular year. Better economic performance enables the government to afford procuring of public goods and services such as health inputs with an aim of providing more health services to the people. The above cited argument explains why the relationship between GDP and the supply of pharmaceuticals and non-pharmaceuticals is positive. A high GDP would imply higher availability of funds that will enable budget allocation to the MOH to accommodate more health related needs such as the required pharmaceuticals and non-pharmaceuticals in the public health facilities.

# CHAPTER FIVE: SUMMARY, POLICY RECOMMENDATIONS AND CONCLUSION

## 5.1 Summary

The principal focus of this study was to empirically examine the factors influencing supply of pharmaceuticals and non-pharmaceuticals in Kenya. Out of the observations made, it has emerged that the quantities of pharmaceuticals and non-pharmaceuticals supplied by MOH to the public health facilities remarkably vary from year to year. This variation in quantities of pharmaceuticals and non-pharmaceuticals is explained by the price of health care, prices of both pharmaceutical and non-pharmaceuticals, population size and Gross Domestic Product (GDP). The results show that both the product price and the unit prices of both pharmaceuticals and non-pharmaceuticals are not significant while population size and GDP are significant in influencing the supply of pharmaceuticals and non-pharmaceuticals by the government to the public health facilities.

From the results, we find that as the product prices increases, the supply of pharmaceuticals and non-pharmaceuticals to the public health facilities also increases. Population growth also leads to a rise in supply of with pharmaceuticals and non-pharmaceuticals by MOH. An increase in population size greatly causes an upward move in the quantity of health inputs provided to health facilities in Kenya. Arise in GDP also causes an increase in the quantity of the pharmaceuticals and non-pharmaceuticals provided to the health facilities. For positive causation, population size is the leading explanatory variable in significance as it is the most significant factor. It is followed by GDP since this is the variable which is the second most significant.

It can therefore be argued that the factors that are significant in determining the quantity of pharmaceuticals and non- pharmaceuticals to procure in order to provide/supply them to health facilities are population size and GDP. The two factors are thus quite important in explaining the changes in the quantities of pharmaceuticals and non- pharmaceuticals that the MOH procures in every year.

## **5.2 Policy Recommendations**

This study has established the significance of the captured explanatory variables on supply of pharmaceuticals and non- pharmaceuticals in Kenya. This bears policy implications, which ought to be addressed with a view to improving health care system in Kenya. The detected significance justifies why the Kenyan government should be considering the determining factors that affect the quantities of pharmaceuticals and non- pharmaceuticals of which the MOH is expected to provide to her public health facilities. Taking such measures would improve efficiency in procurement of pharmaceuticals and non- pharmaceuticals since these factors would rule on the quantities to buy for the health facilities.

Based on the above argument, the explanatory factors deserve a substantial attention in order to form a health policy that is in a position to boost health care services in Kenya. Considering the country's population, the MOH is supposed to procure more pharmaceuticals and non-pharmaceuticals when population size increases hence further equipping the public health facilities. More pharmaceuticals and non-pharmaceuticals would reflect better health care to patients.

The government is advised to peg the quantities of pharmaceuticals and non- pharmaceuticals to procure on GDP. GDP seems to be playing a major role in explaining variation in the procured quantities of these inputs. Bearing these findings in mind, MOH should procure

more pharmaceuticals and non- pharmaceuticals when GDP is high and vice versa. Price of health care is another factor that MOH should consider in the layout of her procurement plan. More pharmaceuticals and non- pharmaceuticals are supposed to be procured when price of health care is high while less should be bought when the price is low. However, this factor is not significant hence the government should not highly consider it when procuring the health inputs. This may mainly be because the government or MOH is not a profit making entity.

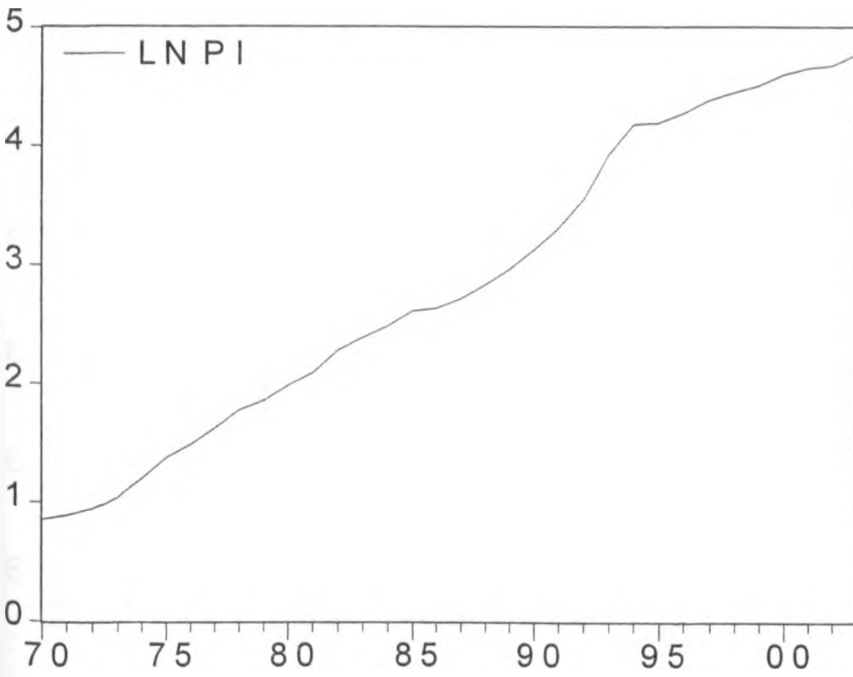
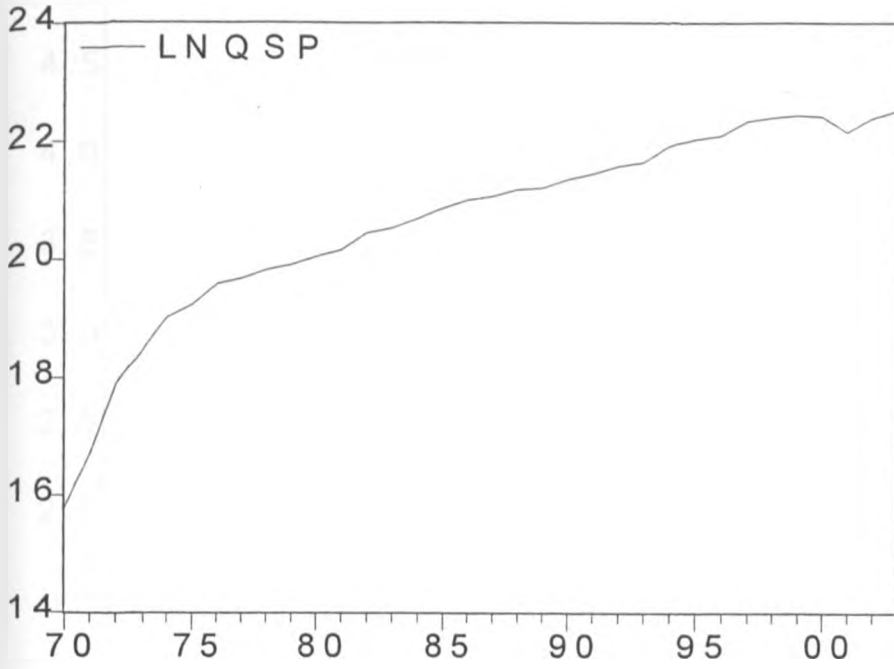
Input unit price has been detected as a factor that is not supposed to be considered when procuring pharmaceuticals and non-pharmaceuticals by MOH. This is due to its statistical insignificance. The aim of the government as it provides health care services to its citizens is not to maximize its profits hence the prices of pharmaceuticals and non-pharmaceuticals are not considered as major ruling factors when procuring the health inputs. As a policy recommendation, MOH is therefore urged not to consider the input unit prices when providing health care services to the public health facilities.

### **5.3 Conclusion**

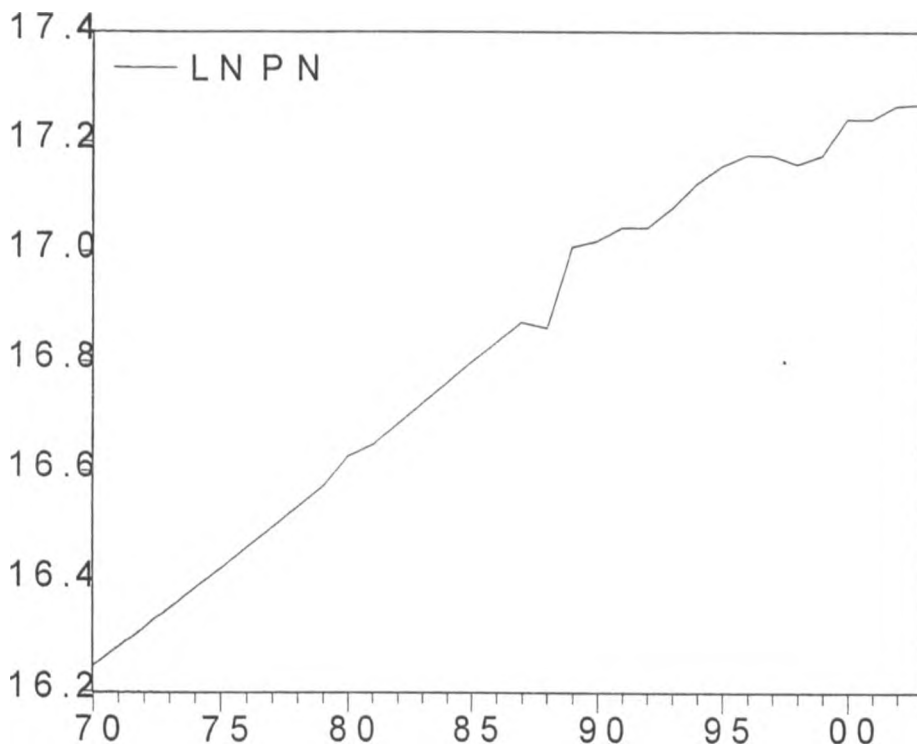
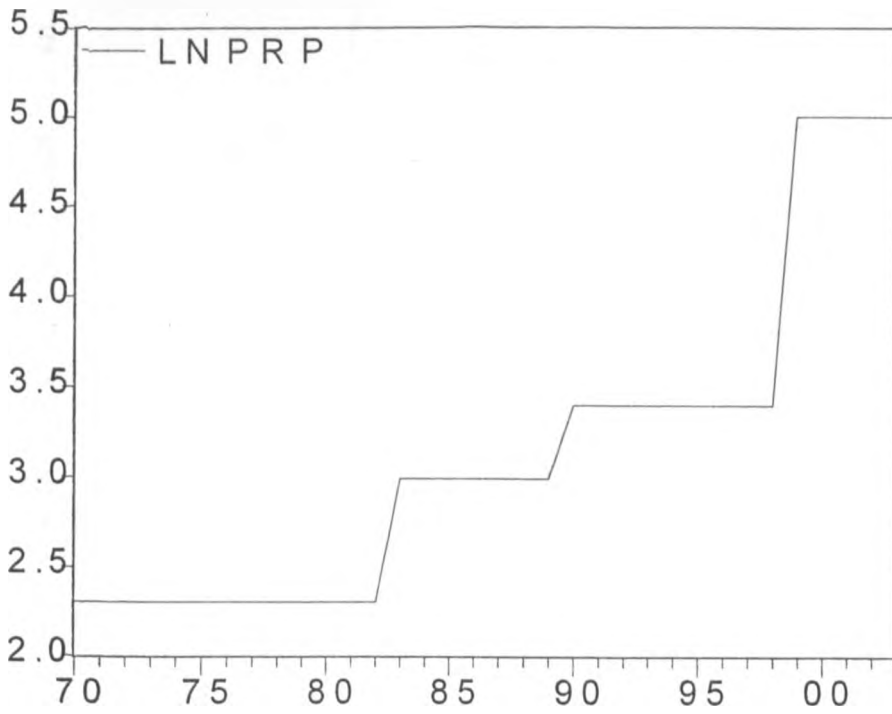
In conclusion, if the above policy recommendations were adopted and fully implemented, the government's role in providing health care to her people would encounter a remarkable breakthrough. Health workers would be more efficient and more properly utilized since public health facilities would be more optimally equipped. Health related resources are very scarce hence calling for rational utilization whose end results will be cost-effectiveness. Sourcing for pharmaceuticals and non-pharmaceuticals deserves an ideal procurement plan that cannot be a reality not unless the planners and procurement bodies e.g. Kenya Medical Supplies Agency (KEMSA) absorb the above policy recommendations in such a plan. The policies recommended in this research paper will therefore act as a guide to policy makers in issues pertaining to procurement within the Kenyan health sector.

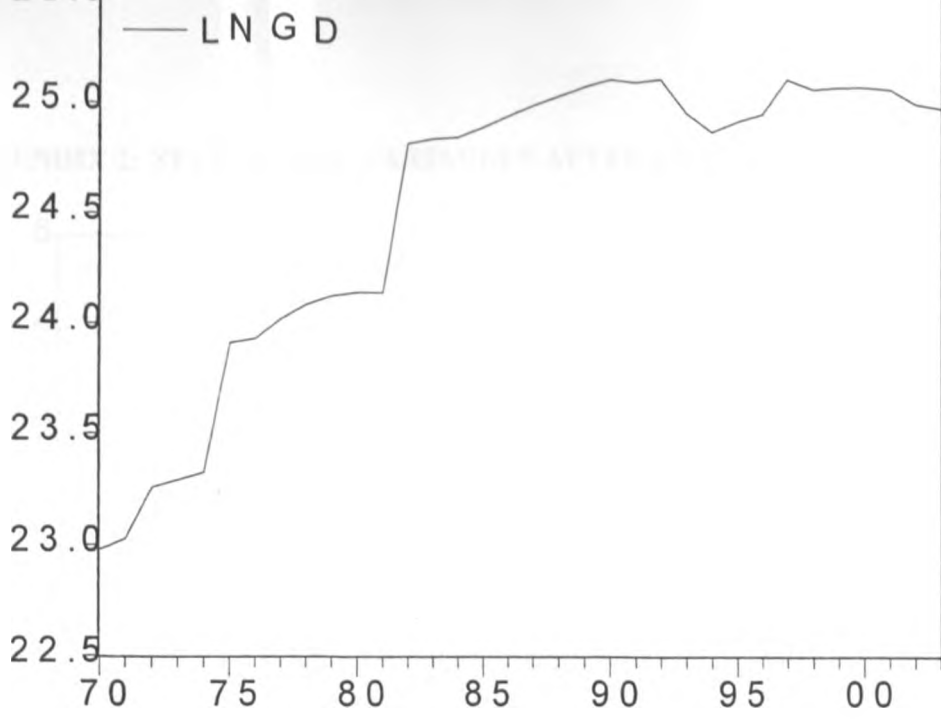
This is practically possible since the results may be used by policy makers, decision makers and researchers to help them create effective mechanism and polices for establishing monitoring, and predicting the variety of needs pertaining to health inputs particularly the pharmaceuticals and non-pharmaceuticals. These findings are essential to health care managers and health resources planners in their efforts to provide efficient mixes of the pharmaceuticals and non- pharmaceutical requirements to support efficient supply of medical supplies.

# APPENDIX 1: NON-STATIONARY VARIABLES AT LEVELS

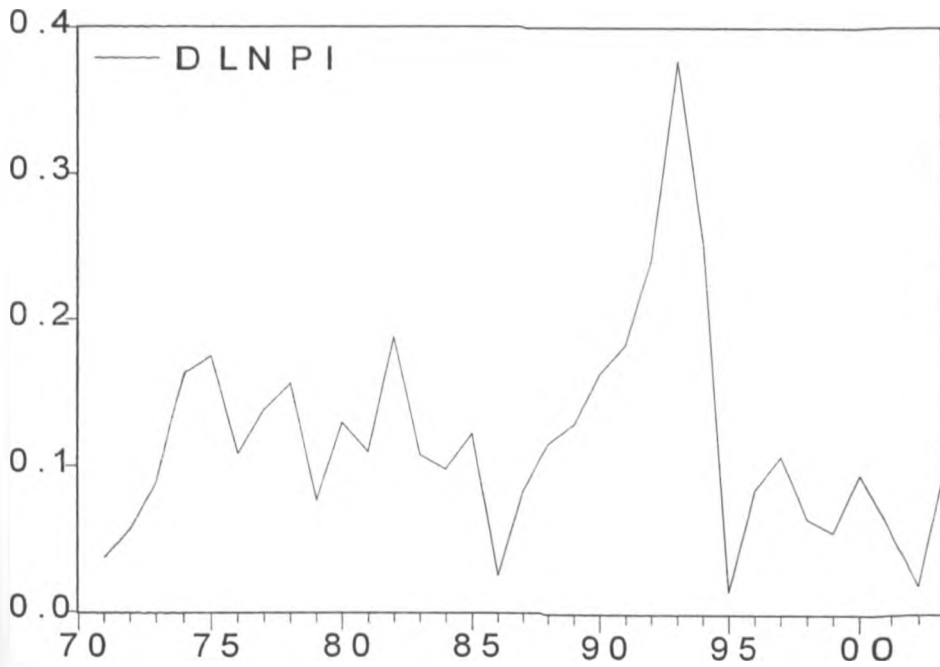
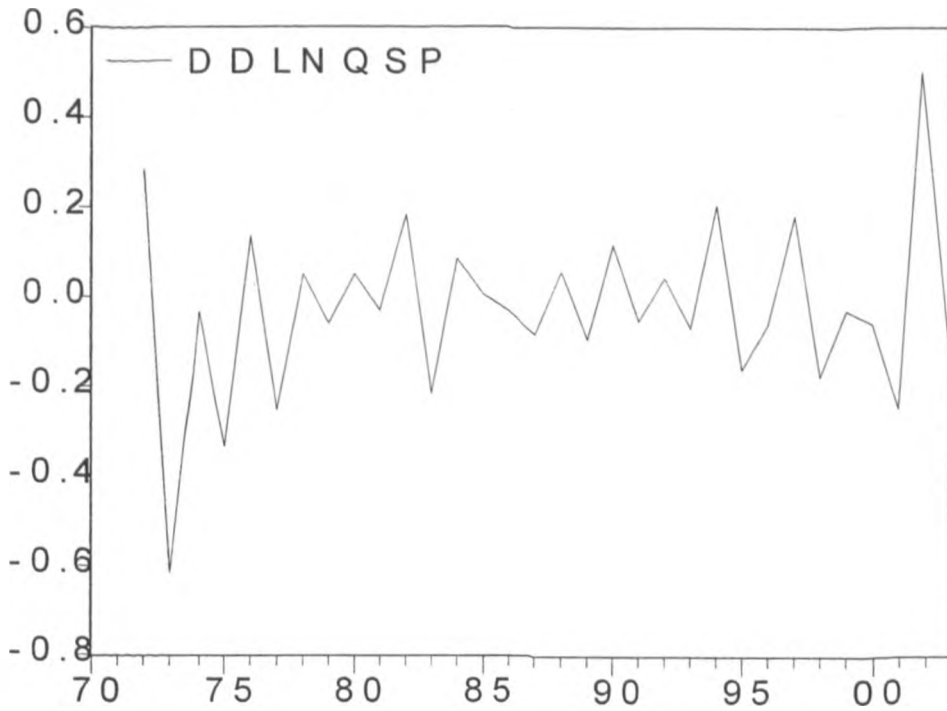


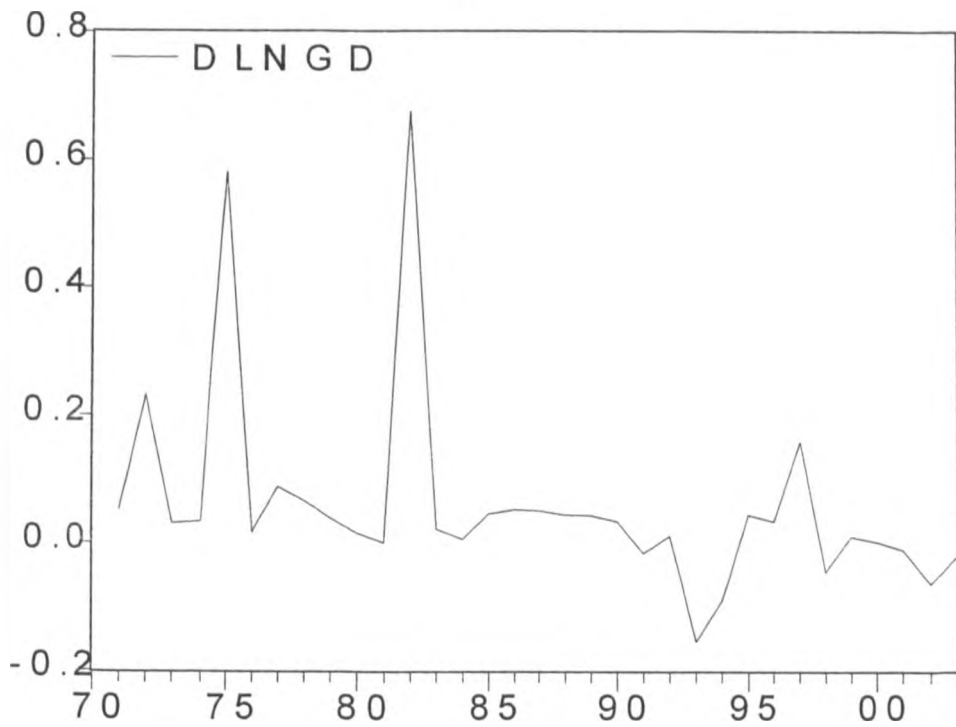
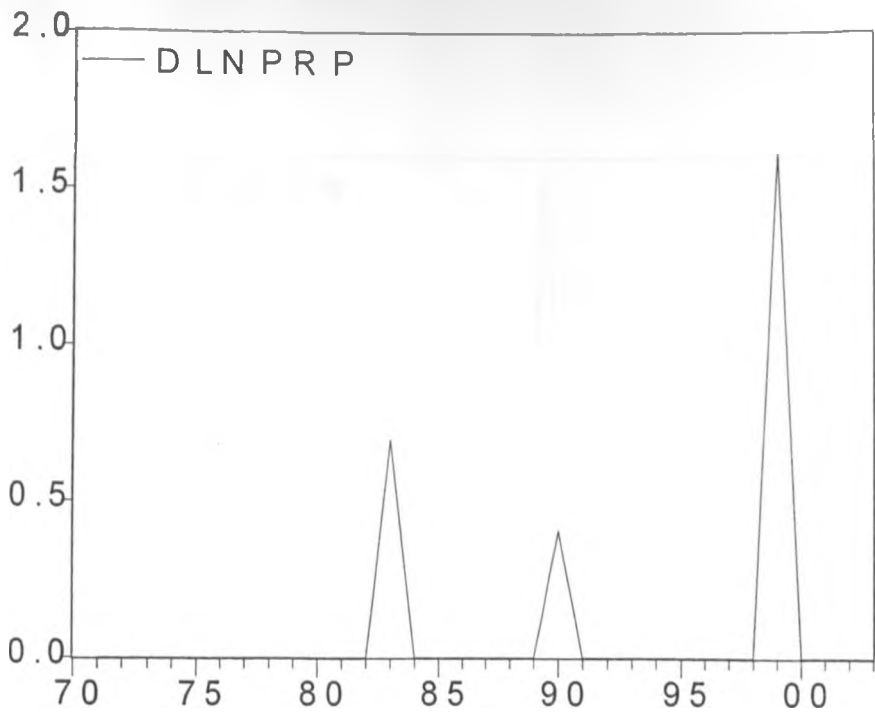


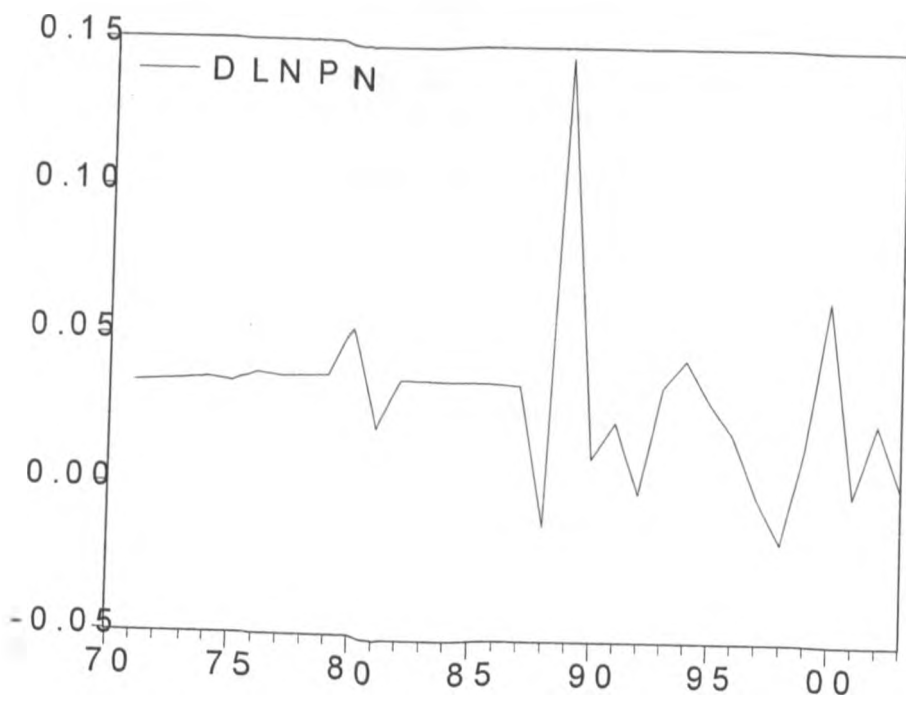




APPENDIX 2: STATIONARY VARIABLES AFTER DIFFERENCING







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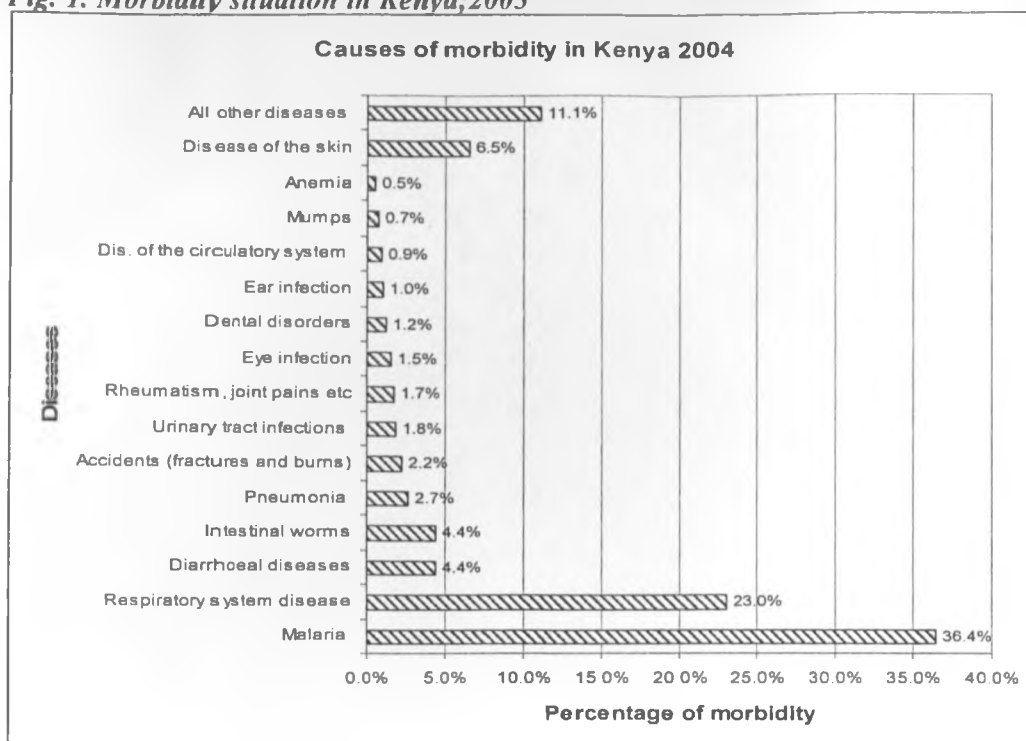
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Fig. 1. Morbidity situation in Kenya;2005



Source: Economic Survey, 2005

Basing sourcing of pharmaceuticals and non-pharmaceuticals by MOH on morbidity, figure 1 can be used as a guide. For instance, the ministry should extend a priority in procuring anti-malarial drugs given that malaria takes the lead in morbidity contributing to 36.4 per cent.

UNICEF (1990) identified vaccine and Oral Dehydrated Therapy (ORT)<sup>2</sup> as important health inputs. ORT is highly recommended for treating water borne diseases while vaccines are more cost effective and given that many conditions have negative externalities, UNICEF advised on distribution of the vaccine freely at highly subsidized prices. When the vaccine was distributed as advocated for by UNICEF, the outcome was that 80 per cent of the population got immunized against polio. In essence, vaccines are administered to induce

<sup>2</sup> Water solution with salt and sugar given to babies in order to rehydrate them after getting dehydrated out of excessive loss of water from their bodies caused by diarrhoea.