

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

# MEDICINE PRICES, AVAILABILITY, AFFORDABILITY AND PRICE COMPONENTS IN SUDAN

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## **Preface**

Drug costs are important, as they account for a substantial part of the total cost of health care, estimated at 10-15% in developed countries and up to 30-40% in some developing countries. In developing countries, most people who need medicines have to pay for them out of their own pockets. Drug prices and drug expenditures have become a major issue in the past few years in developing countries and health care policy makers are concerned that their countries are carrying a heavier burden than others in paying for drugs. Governments use a variety of approaches to try to control the cost of drugs and ensure that essential medicines are affordable and not overpriced. Measuring and understanding the medicines prices situation is the first stage in developing medicines pricing policies that would ensure availability and affordability. Despite the fact that several stakeholders recognize medicines prices are an issue; it could not be addressed in a systematic manner in the past due to lack of a reliable methodology. However, the World Health Organization and Health Action International have undertaken a commendable task to address methodological difficulties in surveying medicine prices.

This report is an outcome of a systematic study employing the World Health Organization/Health Action International (WHO/HAI) methodology and is an attempt to address medicine pricing problems in Sudan. We strongly believe that the findings and the evidence-based recommendations will be useful for developing an effective pricing policy.

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## **Conflict of Interest Statement**

None of the authors of this survey or anyone who had influence on the conduct, analysis or interpretation of the results has any competing financial or other interests.

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## List of abbreviations and acronyms

Cap:	Capsule
CIF:	Cost, Insurance & Freight
CMS:	Central Medical Stores
EML:	WHO. Essential Medicines List
FOC:	Free Of Charge
HAI:	Health Action International
GDP:	Gross Domestic Product
Inh:	Inhaler
Inj:	Injection
IQR:	Interquartile Range the; range or differences between the 25th and 75thpercentiles
IRP:	International Reference Prices
LPG:	Lowest Priced Generic;
MOH:	Ministry of Health
MPR:	Medicine Price Ratio (Median price ÷ IRP)
MSH:	Management Sciences for Health
NGO:	Non-Governmental Organization
NMPB:	National medicines and poisonous board
OB:	Originator Brand products: the original patented pharmaceutical product.
RDF:	Revolving Drug Fund
SDG:	Sudanese pound
Susp:	Suspension
STG:	Standard Treatment Guidelines
Tab:	Tablet
USD:	United States Dollar (also \$)
WHO:	World Health Organization

### Notes:

1. The generic names of medicines used in the report are their International Non-Proprietary Names (INN).
2. When referring to the survey medicines in the text, often only the generic name of the medicine is used.
3. When the term “brand” is used in the text, it should be taken to mean the originator brand.
4. Each survey medicine is strength and dosage form specific. Other strengths and dosage forms may be marketed but they were not surveyed.

# **Executive Summary**

## ***Background***

A field study to measure the availability, pricing, affordability and price components of a number of medicines was undertaken in the public and private sector in Sudan from March 2012 to April 2013 using a standardized methodology developed by the World Health Organization (WHO) and Health Action International (HAI).

## ***Methods***

The total number of medicines included in the survey was 50; 14 global list medicines, 16 regional list medicines and another 20 medicines chosen by the researchers to be included in the survey as supplementary medicines of local importance and frequently used in the country.

Data was collected using a systemic sampling method in six geographical regions in Sudan, namely, Khartoum State, Gezeria State, Northern State, Red Sea State, North Darfur State, and White Nile State. Data on the 50 medicines were collected from a total of 56 outlets (28 public and 28 private sector medicine outlets). Public procurement prices were obtained from the Central Medical Stores (CMS) & Revolving Drug Fund (RDF) in addition to one sample outlet (Mecca organization) which is a charitable organization (NGO).

A customize medicine price data collection form, generated using the computerized workbook that accompanies the WHO/HAI manual, was used to record data from all sector outlets for the 50 medicines. For each medicine in the survey, data were collected for the originator brand – OB- and the lowest- priced generic equivalent –LPG- (generic product with the lowest price available at the facility).

Medicine prices are expressed as ratios relative to the Management Sciences for Health (MSH) International Drug Price Indicator Guide prices for 2010 – considered here as international reference prices (IRP). Dividing the local median unit price by the IRP gives a price ratio expressed as a median price ratio (MPR) which indicates how many times higher or lower priced the medicine is to the reference price.

Using the wage of the lowest-paid unskilled government worker, affordability was calculated as the number of days' wages this worker would need to purchase standard treatments for common conditions.

In addition, the manufacturer's selling price, taxes, mark-ups and other components contributing to the final retail prices of selected medicines were determined for a few medicines as examples.

## **Results**

Based on median MPR, the CMS was procuring lowest priced generics at 1.2 times their international reference price (IRP), while they were selling generics at 2.34 times the IRP. The RDF was procuring lowest priced generics at 1.55 times IRP, and selling generics at 5.13 times the IRP. Both, the federal and state government procurement agencies are purchasing efficiently when buying generics but they sell them at higher prices with mark-ups on procurement tender prices of 95% for CMS and 231% for RDF on average.

In public pharmacies the median MPR for lowest priced generic medicines was 2.99 and 8.03 for originator brands. In private retail pharmacies the median MPR is 3.84 for LPG and 19.37 for originator brands.

Generic medicines were the predominant products in public and private pharmacy sectors (39.5% and 56.6% respectively), while the availability of originator brands were 1.8% in public sector pharmacies and 9.3% for private pharmacy sector.

Comparing our study price results with a previous study conducted 2005 we found there was an increase in the median MPR of OB medicines in private sector by 6.4% (from 18.2 in 2005 to 19.37 in 2012), while there was lowering for lowest-priced generics in the private sector by 27.6% (from 5.3 in 2005 to 3.84 in 2012). There was lowering in MPR of lowest-priced generics in public outlets by 37.5% (from 4.78 in 2005 to 2.99 in 2012). There was a reduction in availability of lowest-priced generics in private outlets by 26.8% (from 84.5% in 2005 to 57.8% in 2012), and by 18.9% in public outlets (from 59.1% in 2005 to 40.2% in 2012).

The affordability of lowest priced generics in the public sector was good for half of conditions in the analysis, with standard treatment costing a days' wage or less. In the private sector, the affordability of lowest price generics was similar to the public sector. The government worker would have to work 2.5 days to pay for 30 days of treatment with OB Glibenclamide for diabetes when purchased from private pharmacies. For LPG Glibenclamide the government worker has to pay about half-a day's salary to buy the medicines in the public and private sectors. One month's treatment of OB Amlodipine for hypertension required about 9.0 days' wages when purchased from private pharmacies. The generic versions of Amlodipine, on the other hand, cost less than one (0.7) a days' wages in both the public and private sectors.

Analysis of costing documents shows that mark-ups are variable among different sectors and among different product types. Wholesale mark-ups were more variable than retail mark-ups among different sectors. The wholesale mark-up in the public sectors ranged from 125% in CMS to 240% in RDF, and in the private sector it was 15%. The retail-up for in the public sectors ranged from 11% in CMS to 50% in RDF, and in the private sector it was constant at 20%. It seems that the public sectors take advantage of the low cost of generics from tenders to make excessive profits.

Comparing prices in Sudan with other countries shows that lowest-priced generics in Sudan have low procurement prices and low private sector patient prices compared to other the countries but higher public sector patient prices. This may confirm that the public sector in Sudan acts more like the private sector but located in public premises. The median MPR of originator brands in the Sudanese private sector was higher than in three Arab countries with much higher GDP per capita namely: Jordan, Lebanon and Kuwait.

## ***Conclusion***

In Sudan, the availability of the surveyed medicines was low in all sectors as both originator brands (less than 10%), and generics (40-50% depending on the sector). Use of generic medicines has been accepted in the country as they are more available than originator brands.

To improve access to medicines, patients should pay procurement prices in the public sector plus a nominal distribution cost. The public sector should not work as private wholesalers and be competitors to importing private companies. Hospitals should not act as private retail pharmacies and be financed by medicine sales revenue but rather through government finance. In both the private and public sectors, considerable price differences were seen between originator brands and lowest-priced generics. In general, originator brands were four times the price of lowest priced generics.

Medicines are often unaffordable for ordinary citizens. The treatment of a chronic disease such as hypertension, where prices were high, availability low and affordability poor, warrants urgent attention. Service providers must be encouraged to dispense cheaper but quality-assured generics to improve the affordability of medicines.

The impact of policy changes made should be measured by establishing a monitoring system to regularly monitor the price, availability and affordability of medicines. The preliminary results of this study suggest that the price reduction policy needs to be reconsidered to make medicines more available and affordable.

Although further investigation is required to obtain a more in-depth understanding of the causes and consequences of medicine pricing and availability, the results of this survey provide broad directions for future research and action.

This study has helped to provide broad insight into current issues related to the price, availability and affordability of key medicines for the treatment of common conditions. The results highlight priority areas for action for the Ministry of Health and others in improving access to affordable medicines. Broad debate and dialogue are now needed to identify how best different players can contribute to the prospect of enhancing accessibility and affordability to essential medicines.

## ***Recommendations***

1. There is a need to review the government's medicines procurement policy
2. Encourage local pharmaceutical manufacturing to produce high demand quality-assured medicines at competitive prices
3. Encourage the registration of medicines to reduce prices of older brands and create competition
4. Use pharmacoeconomics tools and measurements including cost benefit analysis, cost-effectiveness analysis, cost-minimization analysis especially for high-cost single-source medicines
5. To improve affordability, reduce mark-ups in the public sector
6. Increase health insurance services coverage.
7. Review registered CIF prices in order to improve the affordability of medicines in the country
8. Encouraging prescribing by the generic name, dispensing of lower-priced generics and promote the use of generics by patients. This would need to be tied to research into medical practitioner and public attitudes towards generic medicines with appropriately designed educational interventions to increase acceptance. Key to this is ensuring all generics on the market are quality-assured.
9. Develop and promote the concept of a national formulary or standard treatment guidelines (STD) based on evidence-based selection and used in conjunction with national and/or hospital clinical guidelines implemented through therapeutic committees. This will help to identify effective, safe medicines, focus procurement and increase efficiency of the supply system, and provide a tool continued improvement and monitoring of prescribing and patient care
10. Repeat the medicines price survey at regular intervals to monitor the effects of policies on medicine prices and availability. The survey could be widened to all regions and also private hospital medicine prices to get a better picture of the private sector

## Glossary

**Affordability:** Affordability is the cost of treatment in relation to the consumers' income. In this survey, the daily wage of the lowest paid unskilled Sudan government worker is used for comparison with the cost of a defined course of treatment for a specific condition. For acute conditions the treatment is based on 7 days' supply and for chronic conditions it is 30 days' supply.

**Brand premium:** A brand premium is the difference in price between the originator brand and the lowest price generic equivalent.

**Cost, insurance, freight (CIF):** Shipping term meaning the seller must pay the costs, insurance and freight charges necessary to bring the goods to the port of the destination.

**Dispensing fee:** Normally a fixed fee that pharmacies are allowed to charge per prescribed item instead of or in addition to a percentage mark-up is called the dispensing fee. The fee more accurately reflects the work involved in handling a prescription.

**Dosage form:** The administration form of the completed pharmaceutical products is its dosage form, e.g. tablet, capsule, mixture, and injection.

**Essential medicines:** Drugs intended to be available within the context of functioning health system at all times, in adequate quantities, in appropriate dosage forms, with assured quality and adequate information, and at affordable prices.

**Free on board (FOB):** Shipping term meaning the buyer must pay all costs and insurance against risks of damage once goods are loaded for shipping.

**Generic medicine:** A pharmaceutical product usually intended to be interchangeable with the originator brand product, manufactured without a license from the originator manufacturer and marketed after the expiry of patent or other exclusivity rights.

**Originator brand:** Originator brand is generally the product that was first authorized worldwide for marketing (normally as a patented product) on the basis of the documentation of its efficacy, safety and quality, according to requirements at the time of authorization. The originator brand name may vary between countries.

**Mark-up:** A certain percentage added to a purchasing price to cover the cost and profit of the wholesaler or retailer is called the mark up.

**Median:** The median is the value that divides the distribution of data in half. If the observations are arranged in increasing order, the median is the middle observation. The median is a useful descriptive measure if there is an asymmetrical distribution of data or there are one or two

extremely high or low values, which would make the mean unrepresentative of the majority of the data.

**MSH (Management Science for Health) reference prices:**The MSH issues an annual International Price Indicator Guide(<http://erc.msh.org>) that lists the prices from not-for-profit and for-profit suppliers to developing countries for multi-source generically equivalent products and calculates a mean and a median unit price, the latter being used in this survey.

**Percentile:**The range of values containing the central half of a set of observations: that is, the range between the 25th and 75th percentiles (the range including the values that are up to 25% higher or down to 25% lower than the median) is called the interquartile range.

**Procurement price:**In the context of this survey it is the price paid for procuring medicines for public sector.

**Retailer:**A company that sells goods to consumers is the retailer. In the context of this survey the retailer is the community retail pharmacy.

**Retail mark-up:**A percentage added to the retailer's purchasing price to cover his expenses and profit.

**Wholesaler:**A company that buys goods from a manufacturer or importer and sells it to the retailers.

**Wholesale mark-up:**A percentage added to the wholesaler's purchasing price to cover his expenses and profit.

# 1. Introduction, Background and Objectives

## 1.1. Introduction

Drug prices are important, as they account for a substantial part of the total cost of health care, estimated as 10-15% in developed countries and up to 30-40% in some developing countries.<sup>1</sup> In developing countries, most people who need medicines have to pay for them out of their own pockets. Drug prices and drug expenditures have become a major issue in the past few years in developing countries and health care policy makers are concerned that their countries are carrying a heavier burden than others in paying for drugs. Governments use a variety of approaches to try to control the cost of drugs to ensure essential medicines are affordable and not overpriced. Measuring and understanding the medicines prices situation is the first stage in developing medicines pricing policies that would ensure availability and affordability.<sup>2</sup>

Spending on medicines is a major part of the total healthcare budget; however drug prices need to be interpreted in the context of the overall (net) costs to health system. Drugs cost money to buy, but their use may also save costs in other areas. For example, purchasing an appropriate drug may lead to a reduction in the use of other drugs or the length of stay in hospital, the numbers of doctor visits required and also it may reduce the administration and laboratory costs compared with those incurred by using another drug to treat the same disease condition.<sup>3</sup>

Drug monetary values are the most easily available and convenient measures of trade and sales. However, they give a misleading measure of the therapeutic value of medicines. Some of the expensive drugs available today have only modest therapeutic benefits, while many inexpensive medicines are highly effective and relatively safe. The therapeutic value can be measured in different ways. Simple measures of clinical improvement, such as fever reduction or recovery times are widely used. For comparisons across different conditions and interventions, composite assessments such as "healthy life years gained" or "disability-adjusted life years gained" are increasingly being used.<sup>4</sup>

According to the theory of "free market economics," the costs of goods and services are determined by interactions between buyers and sellers and not by government intervention. However, free market economics does not work well at containing the costs of medicines, particularly new medicines, because new medicines are protected by patent law, which legally prevents others from making, using, or selling the medicine for a particular period of time. Therefore, without government intervention, there is nothing to help to push down prices.

## 1.2. Country background

Sudan is an Eastern Mediterranean country covering an area of 1,839,542 square kilometers. In Sudan's 2008 census, the population of Northern, Western and Eastern Sudan and after the secession of South Sudan was recorded to be 33.9 million.<sup>5</sup> The population of metropolitan Khartoum (including Khartoum, Omdurman, and Khartoum North) is growing rapidly and was recorded to be 5.2 million. The country's administrative state is divided into 15 states, each state with a capital city and different small cities and rural provinces Figure (1).

**Figure 1:** A recent map of Sudan after the secession of South Sudan



Sudan is classified as a low-income country, with GNI per capita of US\$ 1.511<sup>6-7</sup> and GDP growth rate 8.3% and annual population growth of 2.1%. The life expectancy at birth for men is 57 years and for women is 58 years<sup>8</sup>. The infant mortality rate is 56.9/1,000 live births. For children under the age of 5, the mortality rate is 78.4/1,000 live births. The maternal mortality rate is 215.6/100,000 live births<sup>9-10</sup>. The 10 leading causes of mortality in hospitals in Sudan are: malignant neoplasm, septicaemia, pneumonia, other heart diseases, acute renal failure, malaria, malnutrition, asthma, disorders of the circulatory system, diabetes mellitus. The 10 leading causes of admission to hospital in Sudan are: delivery and child birth, pneumonia, malaria, diarrhoea & enteric gastritis, caesarean operations, obstetrics & gynaecology disorders, asthma, diabetes mellitus, anaemia and cutaneous abscess.<sup>9</sup>

### **1.3. Health System**

In Sudan, the total annual expenditure on health (THE) in 2010 was SDG (Sudan Pounds) 7,886.5 million (US\$ 3,755.5 million). The total health expenditure is 6.2% of the GDP. The total annual expenditure on health per capita is SDG 257(US\$ 122) <sup>11</sup>. The government annual expenditure on health accounts for 27.8% of the total expenditure on health, <sup>12</sup>with a total per capita public expenditure on health of SDG 71 (US\$ 33.9). The government annual expenditure on health represents 8.7% of the total government budget <sup>9</sup>. Across the total population, 30 % are covered by a public health service, public health insurance or social insurance, or other sickness funds <sup>13</sup>

### **1.4. Pharmaceutical expenditures and regulation**

The total pharmaceutical expenditure (TPE) in Sudan in 2010 was SDG 2,833 million (US\$ 1,349 million). The total pharmaceutical expenditure per capita was SDG 72.3 (US\$ 34.45). Pharmaceutical expenditure accounts for 2.2% of the GDP and makes up 36 % of the total health expenditure. The public expenditure on pharmaceuticals per capita in 2007 was SDG 3.5(US\$1.57). The total private expenditure on pharmaceuticals in 2007 was SDG595.5 million (US\$ 268 million). The annual growth rate of the total pharmaceuticals market value is 52 %.<sup>14</sup>

In Sudan, the law requires marketing authorization (registration) for all pharmaceutical products before marketing from the National Medicines and Poisons Board (NMPB) <sup>15</sup>. In 2009, the number of pharmaceutical products registered in Sudan was 3,702 <sup>16</sup>. The largest 10 companies, in term of sales value rounding out the top ten in 2012 were: Alhikma, Tabouk, Amipharma, Cadila Healthcare, Astra Zeneca, Novartis Pharma, GSK, Sanofi, Remedica and Vitabiotics<sup>17</sup>

Sudan practices a "free market economy" and pay-per-fee system, whereby private dispensaries were set up in government hospitals and the public has to pay for medicines prescribed in these hospitals (except for the first 24 hours emergency inpatients, blood transfusion services, renal dialysis and transplantation and many anticancer therapy). However, medicines prices are still under government control, in which the manufacturer, distributor and retailers have to set their prices under a "price regulation system" according to the Sudan Medicines and Poisons Act 1963, updated 2009.<sup>15</sup>

A previous study using the WHO/HAI methodology for surveying medicine prices and availability was conducted in 2005 in Khartoum State by the Federal Ministry of Health, <sup>18</sup> documented variable availability and high prices in the country compared to international reference prices. For public procurement, the median price ratio (MPR) of lowest priced-generics were below the IRP. Patient prices in the public sector were high at 4.8 for LPG, while in private sector was 18.2 times international reference prices for originator brands and 5.3 times for lowest-priced generics. It was 7.6 for LPG in other NGOs sector. Mean availability varied across sectors: for LPG, it was 52.5% in public sector to 90.0% in the private sector, and

from 0% to 2.5% for OB in public and private sector respectively. In the NGO sector availability was (72. 7%).

### ***1.5. Rationale and objectives of this survey***

In 2008 the Sudan National Medicines and Poisons Board (NMPB) carried out a study that measured prices of drugs marketed in the country. The study reported that 23% and 38% of the studied medicines in the public and private sector respectively were over 10 times the international reference prices.<sup>19</sup> Sudanese health policy makers considered this evidence and felt polices were needed to contain drug prices. In 2010 the NMPB issued a decree on medicine pricing<sup>20</sup> and, according to its regulations, importers were asked to reduce prices between 15%-80% of their registered cost & freight (C&F) prices, without consideration to the unintended negative effects on availability and affordability as a result of discouraging the importation and stocking of medicines.

A price regulation system should be easy and not costly to administer. It should also be objective, transparent and predictable, meaning that there is limited room for regulator's discretion and all parties affected, particularly suppliers, are able to predict prices that will be granted and take their decisions accordingly. If the outcome of the regulation is difficult to predict, suppliers are forced to take decisions with a higher uncertainty, which in the end means they could be less likely to invest.

Whenever a new policy is introduced, it should meet an important objective of reducing prices and improving affordability without compromising availability. Therefore, the researchers who wrote this report wanted to examine the price of selected medicines in Sudan, and their availability and affordability in various sectors in order to assess the impact of the new policy and any unintended consequences of the price intervention.

#### **The objectives of our study were to answer the following questions:**

1. How are medicines priced in Sudan and what is the difference in the prices of originator brand products and their generic equivalents across various sectors and regions of the country?
2. The availability of medicines in Sudan compared to the 2005 study to assess the impact of the NMPB decree on their availability.
3. How affordable are medicines for low-income people in Sudan.
4. Mark-ups and other charges in the supply chain of various sectors.
5. How medicines prices, availability and affordability in Sudan differ to those in countries with similar economic and/or developmental levels.

## **2. Methodology**

### ***2.1. Sampling***

The study followed the WHO/Health Action International (HAI) 2008 methodology.<sup>21</sup> Data was collected using a systemic sampling method in six geographical regions, from a total of 52 outlets as shown in Table (1). Areas 2-6 are within 400 kilometres (one day travelling) from the country's main urban centre (Area 1). Figure 1 illustrates the location of these regions. In each area, one major city and four peripheral cities are chosen. In each area, the main governmental hospital in the major city and four other governmental hospitals or primary health-care centres in the peripheral city/cities were sampled. The peripheral areas were no more than a two-hour drive from the major city. In each survey area, data was collected in the public sector, e.g. primary health-care centres and governmental hospitals, and the private sector, e.g. licensed pharmacies and licensed drug stores which were closest to each public medicines outlet. If there were a number of private outlets close to each public facility, one outlet was selected randomly from the lists of facilities obtained in advance.

The public and private outlets/pharmacies were surveyed on both availability of the medicines and the price the patient pays. We also collected patient prices from 4 Khartoum state Revolving Drug Fund (RDF) outlets and the main store of an NGO (charity) which supplies a group of pharmacies in Khartoum.

Public procurement data were obtained from the Central Medical Store (CMS) 2009 tender – the body responsible for the medicines supply system of the Federal public health facilities- and the Revolving Drug Fund (RDF) 2011 tender- the body responsible for supplying Khartoum State hospitals and the State insurance system. These tender prices were current at the time of the survey.

### ***2.2. Medicines selection***

A total of 50 medicines were included in the survey. All were registered by the NMPB; 43 of them were listed on the 2006 Sudanese Essential Medicines (EML). The list of medicines was composed of 14 WHO/HAI global core medicines; 16 regional core medicines and 20 supplementary medicines selected for local importance and frequently used with high sales volume in the country. For each medicine, data were collected on the same dosage form and strength, and with a recommended pack size (Table 2 & Annex I). For each medicine, data were collected on the originator brand (product identified centrally) and the lowest-priced generic equivalent found at each medicine outlet.

**Table 1:** Survey areas and the number of outlets sampled per each area

Area No.	Survey Areas	No. of Public outlets	No. of Private outlets	Dates of Data Collection
<b>1</b>	Major urban centre (Khartoum State)			
	Khartoum city centre	1	1	16/03/2012
	Omdurman City centre	1	1	15/03/2012
	Khartoum North city centre	1	1	19/03/2012
	Jabel Aolia City	1	1	25/03/2012
	Ombada city	1	1	21/03/2012
<b>2</b>	North of Sudan (Northern State).			
	Dongla city	1	1	8/03/2012
	Argo	1	1	15/4/2012
	Aborgig	1	1	20/4/2013
	Karma	1	1	21/4/2013
<b>3</b>	South of Sudan (White Nile State)			
	Kosti city	1	1	1/05/2012
	Rabak	1	1	2/05/2012
	Tandalti	1	1	5/05/2012
	Algezera Abba	1	1	8/05/2012
	Aljableen	1	1	10/05/2012
<b>4</b>	West of Sudan (North Darfur State)			
	Nyala city	1	1	20/06/2012
	Buram	1	1	20/06/2012
	Kass	1	1	20/06/2012
	Tulus	1	1	20/06/2012
	Greda	1	1	20/06/2012
<b>5</b>	Centre of Sudan (Geziera State)			
	Wad madani city	1	1	11/09/2012
	Hasahisa	0	1	12/09/2012
	Managel	0	1	14/09/2012
	Roffa	0	1	16/09/2012
<b>6</b>	East of Sudan (Red Sea State)			
	Port-sudan city	3	4	9/01/2013
	Swaken	1	1	10/01/2013
<b>7</b>	CMS (Tender & selling prices)	2	0	4/03/2013
<b>8</b>	NGO	1	0	1/04/2013
<b>9</b>	RDF (Tender & selling prices)	5	0	15/04/2013
	<b>TOTAL OUTLETS SURVEYED</b>	<b>32</b>	<b>28</b>	<b>60</b>

**Table 2:**List of medicines surveyed

<p><b>Analgesics:</b></p> <ul style="list-style-type: none"> <li>- Diclofenac 50 mg cap/tab</li> <li>- Ibuprofen 400 mg cap/tab</li> <li>- Paracetamol 500 mg cap/tab</li> <li>- Paracetamol suspension 24 mg/ml</li> </ul>	<p><b>Blood supplements:</b></p> <ul style="list-style-type: none"> <li>- Ferrous sulphate+Folic acid 200+0.4 mg cap/tab</li> </ul>
<p><b>Anti-infectives :</b></p> <ul style="list-style-type: none"> <li>- Albendazole 200 mg cap/tab (non-chewable)</li> <li>- Amoxicillin 500 mg cap/tab</li> <li>- Amoxicillin suspension 50 mg/ml</li> <li>- Amoxicillin+clavulanic acid suspension 25+6.25 mg/ml</li> <li>- Amoxicillin+clavulanic acid tabs 500+125 mg cap/tab</li> <li>- Artesunate+Sulfadoxine+Pyrimethamine 50+500+25 mg cap/tab</li> <li>- Azithromycin 40 mg/ml suspension</li> <li>- Azithromycin caps 250 mg cap/tab</li> <li>- Cefixime suspension 20 mg/ml</li> <li>- Ceftriaxone injection 1 g/vial vial</li> <li>- Chloramphenicol eye drops 0.5%</li> <li>- Ciprofloxacin 500 mg cap/tab</li> <li>- Co-trimoxazole suspension 8+40 mg/ml</li> <li>- Erythromycin 250 mg cap/tab</li> <li>- Fluconazole 150 mg cap/tab</li> <li>- Gentamicin injection 40 mg/ml</li> <li>- Metronidazole 400 mg cap/tab</li> <li>- Metronidazole suspension 40 mg/ml</li> <li>- Nystatin oral drops 100000 IU</li> </ul>	<p><b>Cardiovascular drugs:</b></p> <ul style="list-style-type: none"> <li>- Amlodipine 5 mg cap/tab</li> <li>- Atenolol 50 mg cap/tab</li> <li>- Atorvastatin 20 mg cap/tab</li> <li>- Captopril 25 mg cap/tab</li> <li>- Furosemide 40 mg cap/tab</li> <li>- Lisinopril 10 mg cap/tab</li> <li>- Methyldopa 250 mg cap/tab</li> <li>- Nifedipine Retard 20 mg tab</li> <li>- Simvastatin 20 mg cap/tab</li> </ul>
<p><b>Antihistamines:</b></p> <ul style="list-style-type: none"> <li>- Chlorphenamine maleate 4 mg cap/tab</li> </ul>	<p><b>CNS drugs:</b></p> <ul style="list-style-type: none"> <li>- Amitriptyline 25 mg cap/tab</li> <li>- Carbamazepine 200 mg cap/tab</li> <li>- Diazepam 5 mg cap/tab</li> <li>- Fluoxetine 20 mg cap/tab</li> <li>- Promethazine 25 mg cap/tab</li> </ul>
<p><b>Anti-inflammatory drugs:</b></p> <ul style="list-style-type: none"> <li>- Dexamethasone injection 4mg/ml</li> </ul>	<p><b>Gastro-intestinal drugs:</b></p> <ul style="list-style-type: none"> <li>- Hyoscine 10 mg cap/tab</li> <li>- Loperamide 2 mg cap/tab</li> <li>- Omeprazole 20 mg cap/tab</li> <li>- Ranitidine 150 mg cap/tab</li> </ul> <p><b>Respiratory system drugs:</b></p> <ul style="list-style-type: none"> <li>- Beclometasone inhaler 50 mcg/dose</li> <li>- Cough syrup 0.7+1.25 mg/ml</li> <li>- Salbutamol inhaler 100 mcg/dose</li> </ul>

### ***2.3. Reference price list***

Sudanese prices were compared to an international reference price (IRP), taken from the 2010 International Drug Price Indicator Guide produced by Management Sciences for Health (MSH). These are the medians of recent bulk procurement or tender prices offered by profit and non-profit suppliers to developing countries for multisource products. Dividing the local unit price by the IRP provides a price ratio expressed as a median price ratio (MPR) and it indicates how many times more expensive or cheaper the medicine is than the reference price .e.g. an MPR of 2 would mean that the Sudanese medicine price is twice that of international reference price. The median price ratio (MPR) was used as the summary measure. This facilitates national and international comparisons of medicines prices. MSH prices (in US dollars) were converted to Sudanese Pounds .Due to some logistic factors data collection took six months. Over this time there was increase in prices due to an inflation rate of about 56% which affect the results in some survey regions. At the start of the study (8/3/2012) until 23/6/2012 the rate of exchange and rate of pricing at NMPB was 1 USD = 3.75 Sudanese pounds (SDG). During this time we completed data collection in 4 regions in Sudan (Capital, Northern, Southern and Western regions of Sudan). The rate of exchange changed after 24/6/2012 to 1 USD = 5.85 SDG and during this time we completed data collection in the remaining regions (Gezera state and Eastern Region) in addition to CMS, RDF and NGO sectors, Table (1). After consultation with experts, it was decided to use the exchange rate of 1 USD = 3.75 Sudanese pounds.

### ***2.4. Data collection***

A customize medicine price data collection form generated using the computerized workbook was used to record data from all outlets for the 50 medicines. Data on the price and availability of medicines in the public, private and other sectors (RDF & NGOs facilities) were obtained by collectors during visits to the medicines outlets. The data collectors were pharmacists and pharmacy students from the National University. They were trained on how to fill the data collection form correctly and each completed form was reviewed by the survey manager, after which he entered the data into the workbook. The pack size and price of that pack were only collected if it was physically in stock that day. The exception was in the Western region - Darfur area- as it was not stable at the time of data collection so data collection forms were sent to the pharmacists to complete themselves and return to the investigators.

### ***2.5. Data entry, checking and analysis***

The data were entered in an electronic spreadsheet (Microsoft Excel) adopted specially by WHO/HAI, which automatically calculates MPRs, availability and affordability etc.

### **Data quality assurance included:**

- Checking of the data collection forms at the end of each day of data collection  
Double entry of data into the WHO/HAI workbooks
- Visual inspection of the data once entered by the survey manager.
- Review of the data by HAI.
- Any queries were checked against the data collection form or with the outlet itself.

Comparisons of originator brand and generic medicine prices and between different sectors were determined. In addition the median and interquartile range (IQR) of prices was given.

## ***2.6. Affordability***

The affordability of some standard treatments for those on low wages was assessed by comparing the cost of treatment to the daily wage of the lowest paid unskilled government worker. The values obtained provide a measure of affordability. It was determined that the lowest paid workers receive around SDG 350 per month or SDG 12 per day (\$ 3.20).

## ***2.7. Cost components data***

The manufacturer's selling price, taxes, mark-ups and other components contributing to the final retail prices of selected medicines were determined for a few imported and locally produced medicines as examples in the public, private and RDF sectors. The wholesale and retail prices for medicines in the private sector are set by the NMPB. The C&F prices are published periodically as the Sudan Index and are available on their website [www.nmpb.gov.sd](http://www.nmpb.gov.sd). To obtain more specific information, costing documents of some local agents in the private sector were reviewed looking at the prices of medicines.

## ***2.8. Study Plan Schedule***

**Table 3:** Study plan schedule

<b>Action</b>	<b>Start Date</b>	<b>End Date</b>
Pre-survey preparation	1/1/2012	2/21/2012
Planning the survey	2/22/2012	2/27/2012
Preparation for data collection in the field	3/1/2012	3/7/2012
Data Collection in the field	3/8/2012	4/15/2013
Data entry, analysis and interpretation	1/1/2013	5/31/2013
Price component survey	6/1/2013	6/19/2013
Synthesis of the final report	6/20/2013	9/30/2013
Total Days	21 months (640 Days)	

## 3. Results

### 3.1. Availability

The availability data presented in this study is only the availability of sampled medicines on the day of data collection at each surveyed outlet.

#### 3.1.1. Public sector availability

##### 3.1.1.1. Public pharmacy availability

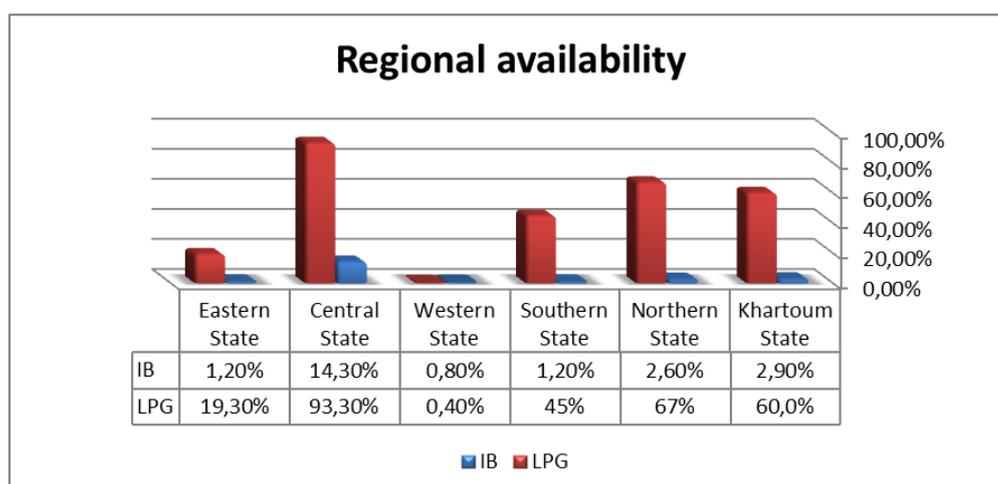
In the public outlets surveyed, generic medicines were the predominant products. The availability of various baskets of medicines is shown in Table (4).

**Table 4:** Availability of different baskets of medicines in the public sector (24 outlets)

Medicines Basket	OB	LPG
Global medicines basket (n=14)	3.6%	40.2%
Regional medicines basket (n=16)	0.6%	37.2%
Supplementary medicines basket (n=20)	1.5%	40.8%
Essential List medicines basket (n = 43)	2.0%	41.2%
All surveyed medicines (n=50)	1.8%	39.5%

The mean percentage availability of all surveyed medicines in the public sector was low at 1.8% for originator brand medicines (OB) and 39.5% for lowest -price generics (LPG). There was a big variation in mean availability among the 6 regions surveyed. The lowest availability was seen in the Western State (a conflict area) at 0.8% for OBs and 0.4% for LPGs. If this area was excluded from the analysis of the public sector, mean availability is higher at 2.1% for originator brand and 50.9% for lowest -priced generics. Availability was highest in the Central State (13.3% OB and 93.3% LPG), where the only public outlet in this state (Wad Madni city) was sampled. Figure 2 shows the mean availability in each survey region.

**Figure 2:** Cross regional availability (%) for OB and LPG in Public sector



For individual medicines, two antidepressant drugs, Amitriptyline and Fluoxetine were not found as either generics or originator brands, in any of the outlets surveyed on the day of data collection despite being on the EML. The highest availability for originator brands were for Salbutamol inhaler (50%), followed by Paracetamol tabs (16.7%), Cefixime suspension (14.3%), Carbamazepine tabs (9.1%) and 0.0% for the remaining originator medicines collection. Availability of 50% or more of generics was found in 36% of surveyed public outlets. Table (5) shows the percentage availability of individual medicines grouped into bands, and Annex II gives the % availability of all surveyed medicines. It is not surprising that medicines with 0% availability were antidepressant drugs as these medicines are mainly found in psychiatric hospitals which we did not survey in our study.

**Table 5:** Availability% (in bands) of generic medicines in public outlets surveyed.

Availability	Medicines
<b>0.0%</b>	Amitriptyline, Fluoxetine.
<b>1.0%-10.0%</b>	Albendazole, Loperamide, Fluconazole, Promethazine, Gliclazide, Simvastatin
<b>11.0%-20.0%</b>	Salbutamol inhaler, Diclofenac.
<b>21.0%-30.0%</b>	Beclometasone inhaler, Diazepam, Atorvastatin
<b>31.0%-40.0%</b>	Azithromycin caps, Captopril, Ibuprofen, Methyl dopa, Amoxicillin suspension, Artesunate+Sulfadoxine+Pyrimethamine, Amoxicillin+clavulanic acid suspension, Cough syrup.
<b>41.0%-50.0%</b>	Azithromycin dry powder suspension, Nifedipine Retard, Co-trimoxazole suspension, Cefixime suspension, Gentamicin injection, Hyoscine, Nystatin oral drops, Ranitidine, Chloramphenicol eye drops, Amoxicillin+clavulanic acid tabs, Carbamazepine, Paracetamol suspension.
<b>51.0%-60.0%</b>	Lisinopril, Amoxicillin, Metronidazole suspension, Metformin, Amlodipine, Ferrous sulphate+Folic acid, Atenolol, Chlorphenamine maleate, Glibenclamide
<b>61.0%-70.0%</b>	Ceftriaxone injection, Dexamethasone injection, Paracetamol, Erythromycin, Furosemide, Omeprazole.
<b>70.0% - 75%</b>	Ciprofloxacin.

Tab/cap unless stated otherwise

Comparing our study results with those in the 2005 price study in Khartoum State for the same medicines surveyed in both years that had the same strength and dosage form, we found there is almost no difference in the availability of originator brands (2.2% in 2005 Vs 2.18% in 2012), while there was a reduction in availability of generics in public outlets i.e. from 59.1% in 2005 to 40.2% in 2012. This is reflected in the availability of some individual medicines (table 6).

**Table 6:** Availability comparison between 2005 & 2012 for selected medicines in public outlets

Medicine name	Survey (2005)		Survey (2012)	
	OB	LPG	OB	LPG
Atenolol	15%	35%	0%	59.1%
Co-trimoxazole susp.	0%	100%	0%	59.1%
Diazepam	0%	95%	0%	27.3%
Furosemide	0%	90%	0%	63.6%
Glibenclamide	0%	100%	0%	59.1%
Hyoscine	5%	100%	0%	54.8%
Loperamide	10%	50%	0%	4.2%
Metronidazole Susp	0%	100%	0%	54.2%
Promethazine	0%	85%	0%	8.3%
Salbutamol inhaler	20%	35%	50%	12.5%

### 3.1.2. Private Sector availability

Medicine availability in the private outlets surveyed was higher than in the public sector for both products types (originators or generic medicines) with generic medicines having the greater availability (but still sub-optimal at less than 60%) . The mean availability of different baskets of medicines is shown in Table (7).

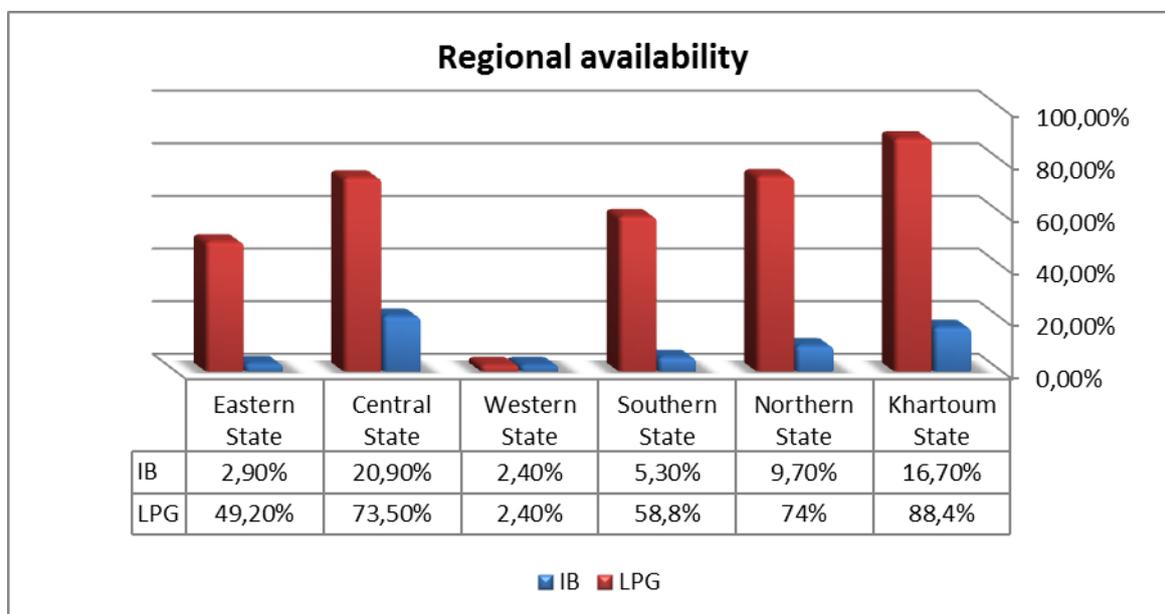
**Table 7:** Availability of different baskets of medicines in the private sector (28 outlets)

Medicines Basket	OB	LPG
Global medicines basket (n=14)	9.2%	57.4%
Regional medicines basket (n=16)	8.5%	54.5%
Supplementary medicines basket (n=20)	10.0%	57.7%
Essential List medicines basket (n = 43)	9.4%	58.0%
All surveyed medicines (n=50)	9.3%	56.6%

The mean percentage availability of all surveyed medicines in the private sector was 9.3% for originator brand medicines (OB) and 56.6% for generics (LPG). Mean availability varied across the 6 regions surveyed. The lowest availability was in Western State (a conflict area) (2.4% OB and 2.4% LPG). If this region is excluded, availability increases to 10.7% for originator brands and 68.3% for generics. The highest availability of OBs was in the Central

State (20.3%) followed by Khartoum State (16.7%). For generics, availability in Khartoum State region was highest (88.4%) followed by Northern and Central state (74.0% and 73.5% respectively). Details are shown in figure (3).

**Figure 3:** Cross regional mean availability (%) for OBs and LPGs, private sector



In the private sector, all medicines were available as generics (but not for every medicine in every outlet) while originator brands were not found for 19 of the 49 originator brands surveyed. The highest availability for originator brands was Paracetamol tabs (42.9%), followed by Cefixime suspension and Carbamezapine tabs (35.7%) each. The percentage availability of individual originator brands is shown in table (8), and annex (III).

**Table 8:** Availability% (in bands) of Originator brands in private outlets surveyed.

Availability	Medicines
<b>0.0%</b>	Amitriptyline, , Amoxicillin, Artensunate+Sulfadoxine+Pyrimethamine, Atorvastatin, Beclometasone inhaler, Captopril, Chloramphenicol eye drops Chlorphenamine maleate,Ciprofloxacin, Dexamethasone injection, Erythromycin , Fluoxetine, Gentamicin injection, Ibuprofen, Loperamide, Methyldopa, Nifedipine Retard, Nystatin oral drops, Promethazine, Simvastatin.
<b>1.0%-10.0%</b>	Amoxicillin suspension,Co-trimoxazole suspension Gliclazide, Hyoscine, Albendazole, Amoxicillin+clavulanic acid suspension, Diazepam, Diclofenac, Metronidazole suspension, Omeprazole, Ranitidine.
<b>11.0%-20.0%</b>	Azithromycin caps, Fluconazole, Paracetamol suspension, Amlodipine, Amoxicillin+clavulanic acid tabs, Azithromycin suspension, Ceftriaxone injection, Lisinopril, Metronidazole.
<b>21.0%-30.0%</b>	Glibenclamide, Metformin, Atenolo, Cough syrup, Furosemide.

<b>31.0%-40.0%</b>	Salbutamol inhaler, Carbamazepine, Cefixime suspension.
<b>≥ 40.0%</b>	Paracetamol.

For generics, only one medicine exceeded 80% availability i.e. Glibenclamide at 85.7%. Table (9) shows the percentage availability of individual medicines grouped into bands, and annexes (IV) gives the mean % availability of all surveyed medicines in the private sector as generics.

**Table 9:** Availability% (in bands) of generics in private outlets surveyed.

<b>Availability</b>	<b>Medicines</b>
<b>21.0% - 30.0%</b>	Albendazole, Fluoxetine.
<b>31.0% - 40.0%</b>	Captopril, Amitriptyline, Simvastatin, Beclometasone inhaler, Cough syrup, Dexamethasone injection, Methyldopa, Salbutamol inhaler.
<b>41.0% - 50.0%</b>	Amoxicillin+clavulanic acid suspension, Atorvastatin, Metronidazole, Artesunate+Sulfadoxine+Pyrimethamine, Fluconazole, Gentamicin injection, Gliclazide, Loperamide, Nifedipine Retard, Paracetamol suspension, Promethazine.
<b>51.0% - 60.0%</b>	Diazepam, Metronidazole suspension, Nystatin oral drops, Cefixime suspension,
<b>61.0% - 70.0%</b>	Azithromycin, Ceftriaxone injection, Diclofenac, Amoxicillin suspension, Amoxicillin+clavulanic acid tabs, Chloramphenicol eye drops, Co-trimoxazole suspension, Hyoscine, Lisinopril, Azithromycin caps, Chlorphenamine maleate, Furosemide, Paracetamol, Ranitidine.
<b>71.0% - 80.0%</b>	Amoxicillin, Atenolol, Ciprofloxacin, Erythromycin, Omeprazole, Carbamazepine, Ferrous sulphate+Folic acid, Ibuprofen, Metformin, Amlodipine.
<b>≥ 80%</b>	Glibenclamide.

Comparing our study results with 2005 price study in Khartoum State for the same medicines surveyed in both years that had the same strength and dosage form, we found there was a reduction in availability of originator brands in private outlets from 19.5% in 2005 to 8.3% in 2012. Also there was a reduction in the mean availability of generics from 84.5% in 2005 to 57.8% in 2012.

**Table 10:** Availability comparison between 2005 & 2012 for selected medicines in private outlets

<b>Medicine name</b>	<b>Survey (2005)</b>		<b>Survey (2012)</b>	
	<b>OB</b>	<b>LPG</b>	<b>OB</b>	<b>LPG</b>
Atenolol	55%	100%	25%	71.4%
Carbamazepine	65%	100%	35.7%	75%
Ceftriaxone	35%	80%	14.3%	60.7%
Diazepam	35%	80%	7%	53.6%

Furosemide	0%	100%	28.6%	67.9%
Hyoscine	45%	100%	3.6%	64.3%
Loperamide	25%	65%	0%	50%
Metformin	35%	80%	21.4%	75%
Omeprazole	5%	90%	7.1%	71.4%
Salbutamol	75%	80%	32.1%	39.3%

### 3.1.3. Availability in the Central Store

Of the 50 medicines surveyed, mean availability of generics was 68% and 16.3% for originator brands however only the central store was surveyed. Medicines not in stock on the day of data collection, as either originator brands or generics, included albendazole, amoxicillin suspension, atorvastatin, captopril, chloramphenicol eye drops, dexamethasone injection, fluoxetine, gliclazide, lisinopril, loperamide, methyldopa and paracetamol suspension.

## 3.2. Prices

The National Medicines and Poisons Board, NMPB is the regulatory body that controls drug pricing from registration to importation, in order to control variations in exchange rates. NMBP periodically revises costing of imported medicines and price increments on account of the rate of inflation and changes in the exchange rate of Sudanese pounds in agreement with Bank of Sudan. As mentioned previously, from 8/3/2012- 23/6/2012 all medicines imported were priced at the rate of exchange 1 USD = 3.75 Sudanese pounds (SDG). During this time we surveyed 4 regions in Sudan (Capital, Northern, Southern and Western regions of Sudan). The rate of exchange and pricing of medicines by the NMPB was changed on 24/6/2012 to 1 USD = 5.85 SDG. This rate of exchange continued till the end of our survey i.e. data collection in the remaining regions (Gezera state and Eastern Region), as well as CMS, RDF, and the NGO. This is a likely cause of the large variation in prices of the same item seen between the regions. So, we are displaying our results first for the whole regions and then as comparative study for regions with inflated exchange rate surveyed.

### 3.2.1. Public sector prices

#### 3.2.1.1. Public procurement prices

For originator brands (OB) only one medicine was procured by CMS and RDF. For CMS it was Salbutamol inhaler with a MPR = 1.88, while for the RDF Carbamazepine was the only originator brand procured and was found to be 16.55 times the international reference price (IRF).

For lowest-priced generics (LPG) tender prices of both CMS and RDF were available as well as

selling prices which enabled us to compare their procurement efficiency in terms of price and how much mark-up they add – as shown in table (11).Based on median MPRs, the CMS was procuring 25 lowest-priced generics at 1.2 times their international reference price (IRP). The interquartile range shows substantial variation in median price ratios across individual medicines with 50% of the median being in the range of 0.86 to 2.37 times the IRP.

If we consider only those 19 generic medicines for which both a procurement price and selling price was available, the federal government procurement agency was purchasing efficiently (medMPR 1.01) then selling to public pharmacies at a 125% mark-up (medMPR 2.28).

The RDF was procuring generics at 1.55 times IRP. The interquartile range shows less variation in median price ratios across individual medicines with 50% being in the range of 1.13 to 2.56 times the IRP.

For 30 lowest-priced generics we were able to compare the RDF procurement price (medMPR 1.55) and their selling price (medMPR 5.26). This shows a mark-up of 240%.

**Table 11:** Shows comparison between CMS & RDF tender & selling prices

Procurement sector	Price type (n= no of medicines)	Median Price Ratio (MPR)		
		Median (IQR)	Minimum	Maximum
Central Medical Stores (CMS)	Tender price (n= 25)	1.20 (0.86 - 2.37)	0.61	10.67
	Selling price (n= 27)	2.34 (1.79 - 5.66)	0.78	18.46
Revolving Drug Fund (RDF)	Tender price (n= 32)	1.55 ( 1.13 – 2.56)	0.17	42.02
	Selling price (n= 44)	5.13 (3.08 - 8.07)	1.18	68.73

As shown in Table 11, overall CMS procurement prices were about 30% less than RDF procurement prices. Individual medicines prices vary according to which organization (CMS or RDF) is procuring. MPRs for a basket of 15 medicines procured by both CMS and RDF. On average MPRs of RDF were three times high priced than CMS for six similar procured medicines and ranged from 113.92% for Amoxicillin suspension to 553.33% to Atenolol, while on average MPRs for CMS were one and half time more expensive than the RDF for nine procured medicines and ranged from 109.09% for Promethazine to 233.3% for Furesamide tablets.

Comparing 2012 RDF procurement prices for LPGs with 2005, we found that the purchasing efficiency of RDF procurement sector in 2005 was better than 2012 as there was increase in median MPRs from 0.47 in 2005 to 1.47 in 2012. MPRs for LPGs for 8 matched items as shown in table (12).

**Table 12:** MPRs comparison between 2005 & 2012 for procurement prices of LPGs purchased through the RDF

	Survey (2005) RDF	Survey (2012) RDF
	MPR	MPR
Chloramphenicol eye drops	0.15	2.78

<b>Ciprofloxacin</b>	0.11	1.59
<b>Erythromycin</b>	0.58	1.34
<b>Furosemide</b>	0.70	1.86
<b>Hyoscine</b>	0.58	0.78
<b>Metronidazole Susp</b>	0.21	0.80
<b>Promethazine</b>	0.37	3.33
<b>Methyldopa</b>	0.56	0.17
<b>median</b>	<b>0.47</b>	<b>1.47</b>

### 3.2.1.2. Public pharmacy patient prices

Table (13) summarizes median MPR's for the different baskets of medicines for both originator brands (OB) and lowest-priced generics (LPG) in public sector outlets (n=24).

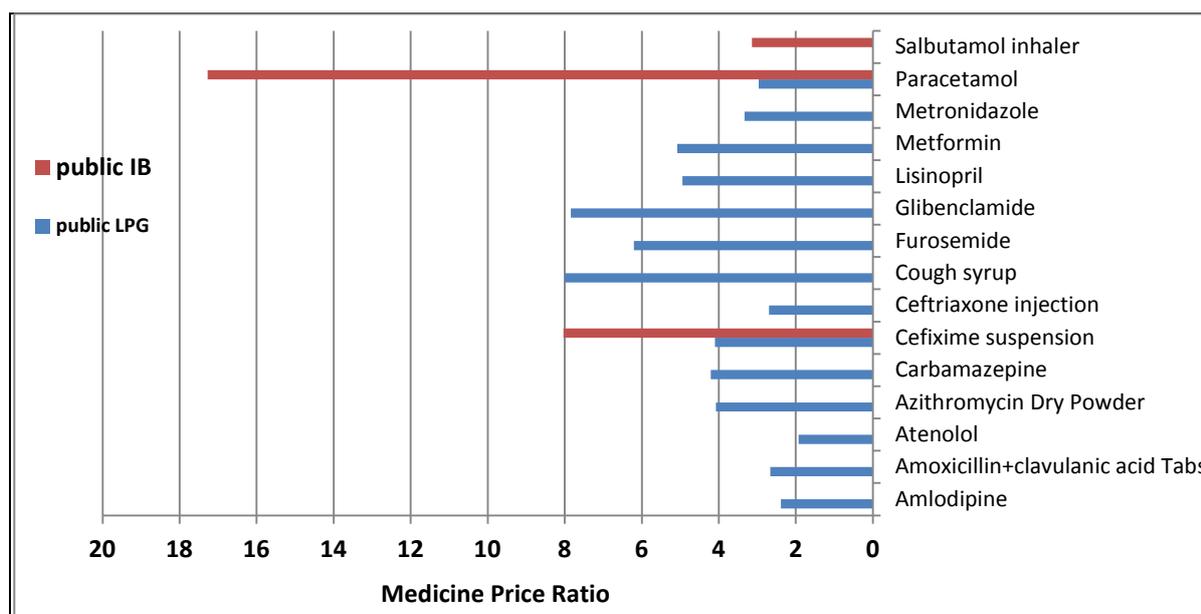
**Table 13:** MPR's for OB and LPG in public sector for different medicine baskets

Medicines Basket	Type and No. of medicines	Median Price Ratio (MPR)		
		Median (IQR)	Minimum	Maximum
<b>Global medicines</b>	Orig.Brand (n= 1)	3.14	3.14	3.14
	Generic (n= 11)	4.37 (3.53-7.81)	1.59	48.06
<b>Regional medicines</b>	Orig.Brand (n= 0)	-	-	1.33
	Generic (n= 13)	3.33 (2.67-5.08)	1.33	6.20
<b>Supplementary medicines</b>	Orig.Brand (n= 2)	12.65	8.03	17.27
	Generic (n= 17)	2.94 (1.72 - 4.86)	0.33	23.93
<b>Essential List medicines</b>	Orig.Brand (n= 3)	8.03	3.14	0.33
	Generic (n= 36)	3.70(2.53 - 5.64)	17.27	23.93
<b>All surveyed medicines</b>	Orig.Brand (n= 3)	8.03	3.14	17.27
	Generic (n= 41)	2.99 (2.28 - 5.63)	0.33	48.06

Unsurprisingly few originator brand medicines were found in the public sector pharmacies (only 3 OBs compared to 41 generics from a total of 50 medicines). The median MPR for all survey medicines for OBs was 8.03. The MPR for individual OBs was OB Cefixime suspension (8.03), Paracetamol tabs (17.27) and Salbutamol inhaler (3.14).

Only two medicines were found as both OB and LPG equivalents (Cefixime suspension and Paracetamol tabs). For these two medicines, originator brands were about four times the price of the lowest-priced generic (on average). The MPRs for OBs and LPG are shown in Fig (4).

**Figure 4:** Medicine price ratio, public sector patient prices, for selected medicines



Overall, lowest-priced generics had a median MPR of 2.99 (n= 41). The 25th and 75th percentiles were 2.28 and 5.63 respectively, indicating a modest variation across the facilities.

The regional comparison showed that Khartoum State had the highest median MPR for lowest-priced generics (3.96), while they were lowest in the Northern and Southern States (2.82 and 2.68 respectively). If we exclude areas with inflated exchange rates (Central and Eastern States) from the analysis the median MPR for LPGs was lower at 2.99 (n=41 medicines).

Comparing our study results with previous 2005 price study in Khartoum state we found that there was a decrease in MPR of lowest-priced generics in public outlets from 3.88 in 2005 to 2.96 in 2012. MPRs of LPGs for 20 matched items which could be compared and is shown in table (14). Data of this table was adjusted for inflation, or purchasing power parity (PPP) as both surveys were done in Sudan.

**Table 14:** MPRs comparison between 2005 & 2012 for selected LPGs in public outlets

	Survey (2005)	Survey (2012)
	MPR	MPR
<b>Atenolol</b>	6.14	4.21
<b>Carbamazepine</b>	4.14	2.7
<b>Ceftriaxone</b>	2.34	13.14
<b>Chloramphenicol eye drops</b>	1.70	2.93
<b>Chlorphenamine</b>	10.05	2.93
<b>Co-trimoxazole</b>	1.77	1.59
<b>Ciprofloxacin</b>	4.78	4.36
<b>Diazepam</b>	4.78	4.37
<b>Erythromycin</b>	3.23	2.58
<b>Furosemide</b>	2.09	6.2

Hyoscine	1.79	0.98
Gentamicin inj	7.93	2.99
Gilbenclamide	5.92	7.84
Metformin	7.44	5.08
Methyldopa	1.57	0.33
Metronidazole Susp	3.22	1.51
Nifedipine Retard	7.86	5.63
Nystatin oral drops	1.52	1.16
Omeprazole	5.21	6.35
Ranitidine	3.61	2.67
<b>median</b>	<b>3.88</b>	<b>2.96</b>

### 3.2.2. Private sector patient prices

Table (15) summarizes the median MPRs for different medicines basket for both types brand (OB) and lowest-priced generic (LPG) medicines in private sector outlets (n = 28).

**Table 15:** MPR's comparison of OB and LPG at private sector for different medicine baskets

Medicines Basket	Type and No. of medicines	Median Price Ratio (MPR)		
		Median (IQR)	Minimum	Maximum
Global medicines	Brand (n= 4)	30.93 (18.81 - 38.38)	3.92	39.22
	Generic (n= 14)	5.69 (3.21 - 7.01)	1.10	35.14
Regional medicines	Brand (n= 5)	24.14(16.82 - 29.39)	15.24	51.68
	Generic (n= 16)	3.49 (2.63 - 6.47)	1.56	15.21
Supplementary medicines	Brand (n= 6)	18.41 (11.68 - 19.23)	5.11	30.84
	Generic (n= 20)	2.93 (2.04 - 10.10)	0.27	47.13
Essential List medicines	Brand (n= 14)	21.57 (15.63 - 30.47)	3.92	51.68
	Generic (n= 43)	4.08(2.82 - 6.99)	0.27	47.13
All survey medicines	Brand (n= 15)	19.37 (16.03 - 30.11)	3.92	51.68
	Generic (n= 50)	3.84 (2.40 - 7.07)	0.27	47.13

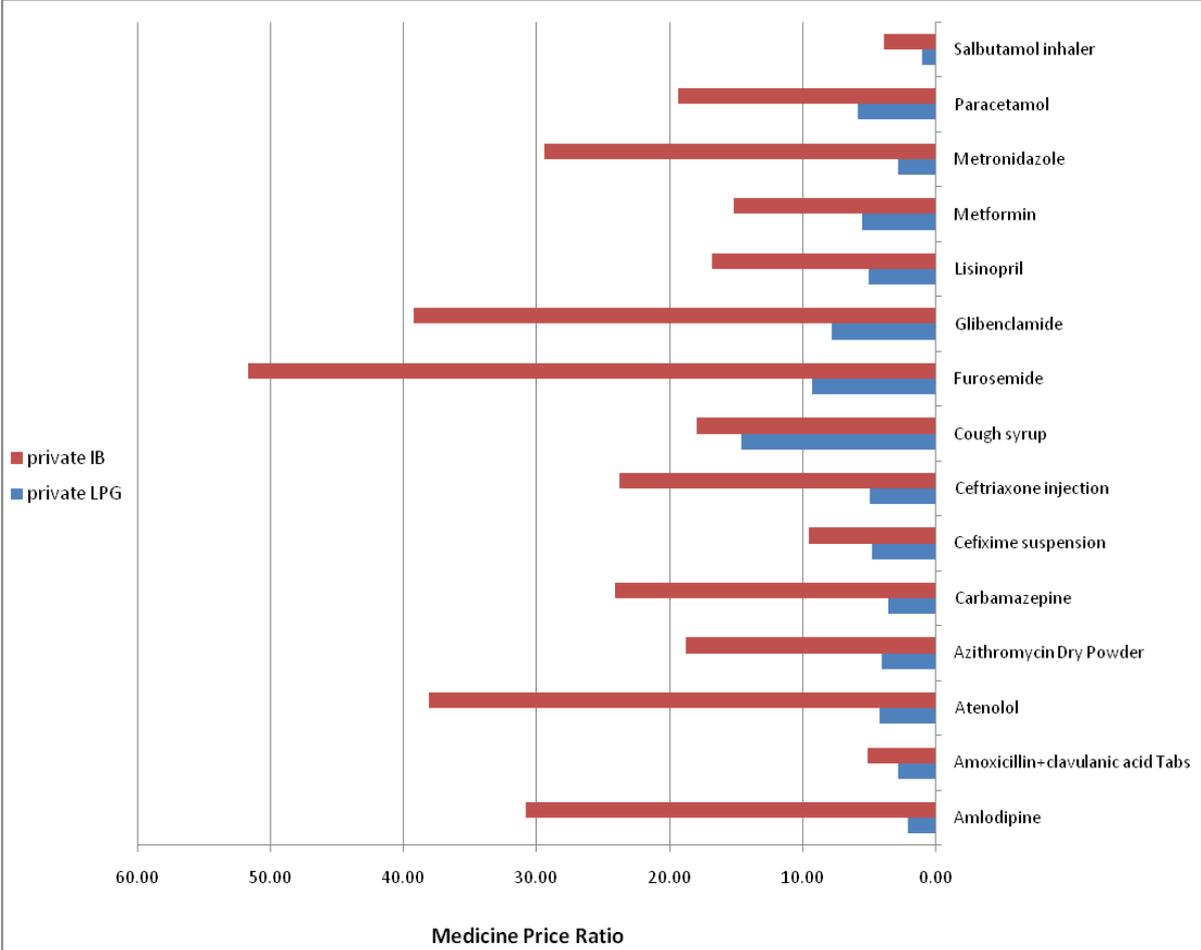
OB medicines were more widely found compared to the public sector. 15 MPRs were calculated for OB prices vs. 50 for LPGs out of a total of 50 surveyed medicines. The median MPR for originator brand medicines was 19.37. Of the OB medicines, Furosemide was found to be the highest priced at over 50 times the international reference price. Other OB medicines with extremely high MPRs included Glibenclamide (39.22), Atenolol (38.10), and Amolpina (30.84) -all were over 30 times more expensive than the IRP.

Fifteen (15) matched pairs of medicines were found for comparison between the originator brand and the lowest-priced generic equivalent. The median brand premium was 4.04 (meaning that, on average, originator brands were about four times the price of lowest priced generics). The median MPR for OBs and LPGs is shown in Fig (5), which shows how much more OBs were priced compared to their LPG equivalents.

For lowest-priced generics the median MPR was 3.84, the 25th and 75th percentiles were 2.40 and 7.07 respectively, indicating a larger variation across the pharmacies compared to originator brands.

LPG medicines found to be over 30 times higher than the IRP were Fluconazole (47.13), Diclofenac (35.14) and Ferrous sulphate + folic acid (30.77).

**Figure 5:** Medicine price ratio in private sector for selected OBs and LPGs



The regional comparison showed a lower median MPR for Khartoum and Northern State (3.6 and 3.02 respectively), while it was higher for Southern, Central and Eastern States (4.36, 5.93

and 8.3 respectively). If we exclude areas with inflated exchange rate (Central and Eastern States) from analysis the MPR will be lowered to be 3.6 (n=50) for LPGs.

Comparing our study results with the 2005 price study we found there was an increase in MPR of OB medicines in the private sector from 11.78 in 2005 to 23.77 in 2012 (across 5 medicines). For lowest-priced generics, overall there was only a very small decrease in price from a median of 5.20 in 2005 to 5.02 in 2012. MPRs of 5 IBs and 25 LPGs matched items which could be compared were shown in tables (15 &16).

**Table 16:** MPRs comparison between 2005 & 2012 for selected OB in private outlets

	Survey (2005)	Survey (2012)
	MPR	MPR
<b>Atenolol</b>	54.01	38.10
<b>Carbamazepine</b>	14.70	24.14
<b>Ceftriaxone</b>	6.56	23.77
<b>Metformin</b>	11.78	15.24
<b>Salbutamol</b>	3.41	3.92
<b>median</b>	<b>11.78</b>	<b>23.77</b>

**Table 17:** MPRs comparison between 2005 & 2012 for selected LPG in private outlets

	Survey (2005)	Survey (2012)
	MPR	MPR
<b>Amitriptyline</b>	8.37	7.02
<b>Atenolol</b>	6.93	4.21
<b>Carbamazepine</b>	3.94	3.6
<b>Captopril</b>	5.31	7.78
<b>Ceftriaxone</b>	1.04	5.02
<b>Chloramphenicol eye drops</b>	1.70	2.78
<b>Chlorphenamine</b>	20.10	17.78
<b>Ciprofloxacin</b>	11.36	6.97
<b>Co-trimoxazole</b>	2.96	1.9
<b>Diazepam</b>	9.57	6.56
<b>Erythromycin</b>	4.04	2.80
<b>Fluconazole</b>	34.32	47.13
<b>Gentamicin</b>	10.43	2.99
<b>Gilbenclamide</b>	7.01	7.84
<b>Hyoscine</b>	2.56	1.96
<b>Loperamide</b>	14.10	10.87
<b>Metformin</b>	4.96	5.59
<b>Methyl dopa</b>	2.94	0.27
<b>Metronidazole Susp</b>	4.42	1.51
<b>Nifedipine Retard</b>	8.14	6.26
<b>Nystatin</b>	1.82	1.40
<b>Omeprazole</b>	5.21	6.35

Promethazine	12.56	9.85
Ranitidine	3.02	3.00
Salbutamol	1.55	1.10
<b>median</b>	<b>5.21</b>	<b>5.02</b>

### 3.2.3. Comparison of Prices in the Public and Private Sector

Figure 6 shows MPRs in the public and private sectors for 15 selected medicines (OBs and LPGs). As shown there were some large variations in price for some medicines between the public and private sectors.

**Figure 6:** Comparison between OB and LPG in private and public sectors for selected medicines

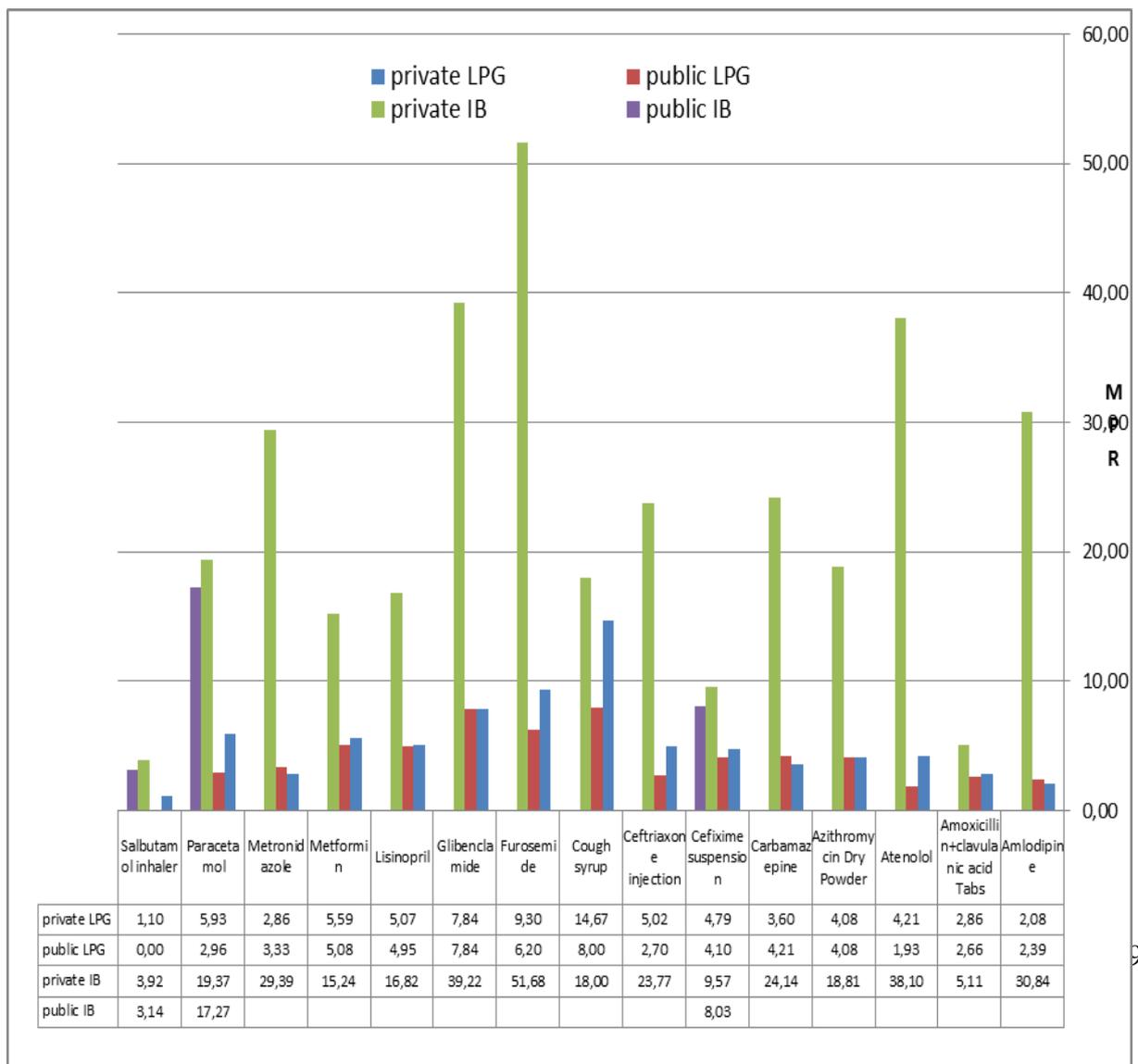


Table (18) shows the comparison of median MPR for medicines found in both public and private sectors (paired analysis). Overall, OB medicines were found to be 19.1% higher priced in the private sector than the public sector but this was based on only 3 medicines. LPG medicines were found to be 14.6% higher priced in the private sector compared to the public sector (across 41 medicines).

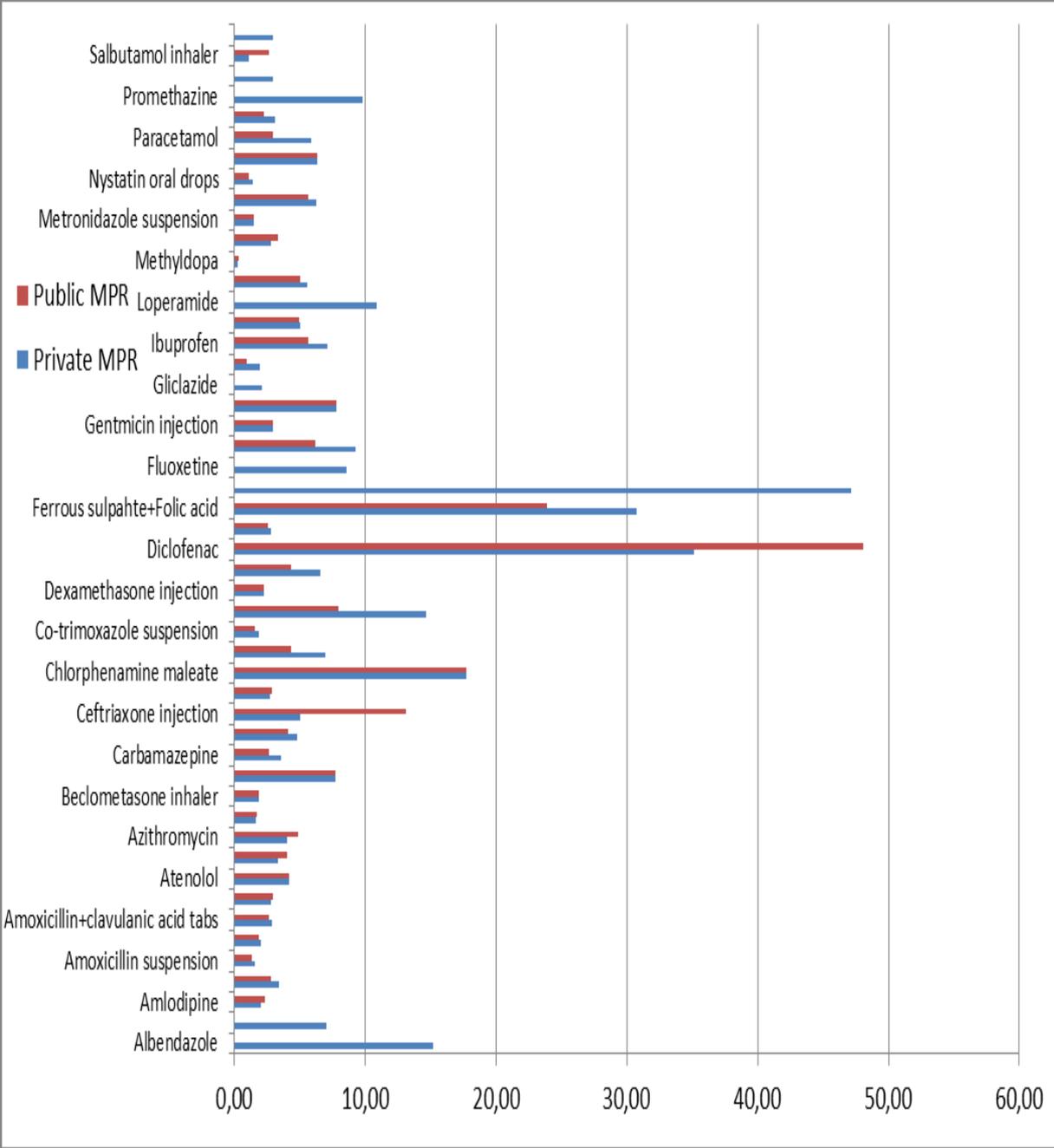
**Table 18:** Comparison between median MPRs in public and private sectors

<b>Medicine Type</b>	<b>Median MPR, Public sector ( n= 24 outlets)</b>	<b>Median MPR, Private sector ( n= 28 outlets)</b>	<b>No. of medicines in both sectors</b>	<b>% difference of private to public</b>
<b>Originator brand</b>	8.03	9.57	3	19.1%
<b>Low-generic brand</b>	2.99	3.43	41	14.6%

In the table above only medicines found in both the public and private sectors for each medicine type (OB and LPG) were included in the analysis to compare prices in the two sectors. If we exclude the inflated exchange rate areas (Central and Eastern States) the difference in median MPR for LPG medicines between public to private sectors is reduced from 14.6% to 0.9%, which means that the public sector prices was almost the same as the private sector prices before inflation.

Comparison details between public and private sector patient prices for all LPGs is shown in figure (7), and we can observe that about 50 % of public sector prices have similar or higher prices than those in the private sector (8 LPG medicines have the same prices in the two sectors and 11 LPG medicines were higher priced in the public sector than in the private sector).

**Figure 7:** Comparison between private and public sectors for LPG surveyed medicines.



**3.2.4. NGO sector patient prices**

The NGO sampled had high overall patient prices which may indicate that they purchase from private wholesalers rather than procure through tenders, or they charge a very high mark-up on medicines (Table 19), however, we are not sure about this as only 1 outlet was sampled.

Four medicines were found for comparisons between originator and lowest-priced generic equivalent (paired analysis). The median brand premium was 12.54 (31.48 for OB/ 2.51 for LPG) meaning that overall the originator price was over twelve times the lowest generic price).

**Table 19:** MPRs in NGO (paired analysis of 4 medicines)

Medicine Type	Median MPR	25th percentile	75th percentile	Minimum	Maximum
Originator brand	18.42	4.96	87.95	2.22	267.06
Lowest-priced generics	5.01	3.38	7.23	1.92	99.22

### 3.3. The affordability of standard treatment regimens

The affordability of 22 treatments for 12 common conditions (Table 20) was assessed as the number of day's wages of the lowest-paid unskilled government worker needed to purchase medicines prescribed at a standard dose. For acute conditions, treatment duration was defined as a full course of therapy (usually 7 days), while for chronic diseases, the affordability of 30-days' supply of medicines was determined. The daily wage of the lowest-paid unskilled government worker in the analysis was 12.00 SDG.

**Table 20:** Number of days' wages of the lowest paid government worker needed to purchase standard treatments

Disease condition and standard treatment			Day's wages to pay for treatment			
Condition	Drug name, strength, dosage form	Treatment schedule	Public sector		Private sector	
			Originator Brand	Lowest-priced generic	Originator Brand	Lowest-priced generic
Asthma	Salbutamol 100 mcg/dose inhaler	1 inhaler of 200 doses	1.7		2.1	0.6
	Beclometasone 50 mcg/dose inhaler	1 inhaler of 200 doses		1.4		1.4
Diabetes	Glibenclamide 5 mg cap/tab	2 cap/tab x 30 days = 60		0.5	2.5	0.5
	Gliclazide 80 mg cap/tab	1 cap/tab x 30 days = 30				1.3
Hypertension	Atenolol 50 mg cap/tab	1 cap/tab x 30 days = 30		0.4	3.4	0.4
	Captopril 25 mg cap/tab	1 cap/tab x 2 x 30 days = 60		1.8		1.8
	Amlodipine 5 mg cap/tab	1 cap/tab x 30 days = 30		0.7	8.9	0.7
Hypercholesterolaemia	Simvastatin 20 mg cap/tab	1 cap/tab x 30 days = 30				1.6
	Atorvastatin 20 mg cap/tab	1 cap/tab x 30 days = 30		2.4		2.0

<b>Depression</b>	Amitriptyline 25 mg cap/tab	1 cap/tab x 30 days = 30				1.5
<b>Adult respiratory infection</b>	Ciprofloxacin 500 mg cap/tab	1 cap/tab x 2 x 7 days = 14		0.6		0.9
	Amoxicillin 500 mg cap/tab	1 cap/tab x 3 for 7 days = 21		0.5		0.7
	Ceftriaxone 1 g/vial injection	1 vial		2.8	5.1	1.1
	Amoxicillin+clavulanic acid 500+125 mg tabs	1 cap/tab x 2 x 7 days = 14		2.2	4.2	2.3
<b>Pediatric respiratory infection</b>	Co-trimoxazole 8+40 mg/ml suspension	5 ml x 2 x 7 days = 70 ml		0.1		0.2
	Amoxicillin 50 mg/ml suspension	5 ml x 3 x 7 days = 100 ml		0.3		0.3
	Amoxicillin+clavulanic acid 25+6.25 mg/ml suspension	5 ml x 3 x 7 days = 100 ml		1.2		1.3
<b>Anxiety</b>	Diazepam 5 mg cap/tab	1 cap/tab x 7 days = 7		0.1		0.1
<b>Arthritis</b>	Diclofenac 50 mg cap/tab	1 cap/tab x 2 x 30 days = 60		3.9		2.8
<b>Pain/ inflammation</b>	Paracetamol 24 mg/ml suspension	5 ml x 3 x 3 days = 45 ml		0.1		0.2
<b>Ulcer</b>	Omeprazole 20 mg cap/tab	1 cap/tab x 30 days = 30		1.8		1.8
<b>Epilepsy</b>	Carbamazepine 200 mg cap/tab	1 cap/tab x 2 x 30 days = 60		0.8	6.7	1.0

The government worker would have to work 2.5 days to pay for 30 days of treatment with OB Glibenclamide for diabetes when purchased from private pharmacies. For LPG Glibenclamide he/she has to pay much less i.e. half a day's salary to buy the medicine in the public and private sectors. One month's treatment of OB Amlodipine for hypertension required about 9.0 days' wages when purchased from private pharmacies. The lowest priced generic versions of Amlodipine, on the other hand, cost less than one (0.7) days' wages in both the public and private sectors.

The affordability of lowest priced generics in the public sector was good for half of conditions, with standard treatment costing a days' wage or less for 53.3% of treatments. Treatments costing over a days' wage for the lowest paid unskilled government worker purchased in the

public sector include paediatric respiratory infection Amoxicillin+ Clavulanic acid 25+6.25 mg/ml suspension 5 ml x 2 x 7 days (1.2 days' wages), asthma Beclometasone 50 mcg/dose inhaler 1 inhaler of 200 doses (1.4 days' wages), hypertension Captopril 25 mg cap/tab 1 cap/tab x 2 x 30 days (1.8 days' wages), adult respiratory infection Amoxicillin+clavulanic acid 500+125 mg cap/tabs 1 cap/tab x 2 x 7 days (2.2 days' wages), hypercholesterolaemia Atorvastatin 20 mg cap/tab 1 cap/tab x 30 days (2.4 days' wages), adult respiratory infection Ceftriaxone 1 g/vial injection 1 vial (2.8 days' wages), arthritis Diclofenac 50mg cap/tab 1 cap/tab x 2 x 30 days (3.9 days' wages) and omeprazole 20mg x 30 caps to treat an ulcer (1.8 days) .

In the private sector, the affordability of lowest price generics was similar to the public sector. Treatments costing over a days' wage of the lowest paid government worker include adult respiratory infection Ceftriaxone 1 g/vial injection 1 vial (1.1 days' wages), diabetes Gliclazide 80mg cap/tab 1 cap/tab x 30 days (1.3 days' wages), paediatric respiratory infection Amoxicillin+clavulanic acid 25+6.25 mg/ml suspension 5 ml x 2 x 7 days (1.3 days' wages), asthma Beclometasone 50 mcg/dose inhaler 1 inhaler of 200 doses (1.4 days' wages), depression Amitriptyline 25 mg cap/tab 1 cap/tab x 30 days (1.5 days' wages), hypercholesterolaemia Simvastatin 20 mg cap/tab 1 cap/tab x 30 days (1.6 days' wages), hypertension Captopril 25 mg cap/tab 1 cap/tab x 2 x 30 days (1.8 days' wages), ulcer Omeprazole 20 mg cap/tab 1 cap/tab x 30 days (1.8 days' wages), hypercholesterolaemia Atorvastatin 20mg cap/tab 1 cap/tab x 30 days (2.0 days' wages), adult respiratory infection Amoxicillin+clavulanic acid 500+125 mg cap/tabs 1 cap/tab x 2 x 7 days (2.3 days' wages), arthritis Diclofenac 50mg cap/tab 1 cap/tab x 2 x 30 days (2.8 days' wages).

When originator brand medicines are prescribed and dispensed in the private sector, none of the treatments would be affordable. For example, treating asthma with Salbutamol costs 2.1 days' wages, treating hypertension with Amlodipine costs 8.9 days' wages, and preventing epilepsy with carbamazepine requires 6.7 days' wages.

It should be noted that treatment costs refer to medicines only and do not include the additional costs of consultation and diagnostic tests. Further, many people in Sudan earn less than the lowest government wage; as such even treatments which appear affordable are too costly for the poorest segments of the population. Finally, even where individual treatments appear affordable, individuals or families who need multiple medications may quickly face unmanageable drug costs. An example is provided below of a family where the father has hypertension and the child has asthma and mother has adult respiratory infection. If the family is earning the equivalent of the lowest-paid government worker's salary, total treatment costs are 4.0 days' wages in the public sector and 4.1 days' wages in the private sector if the lowest price generics are purchased. If originator brands are purchased, treatment costs about 7 days' wages in the private sector excluding an inhaler (Table 21).

**Table 21:** Affordability of treatment for a family with hypertension, asthma and ARI: Number of days' wages of the lowest paid government worker needed to purchase standard treatments:

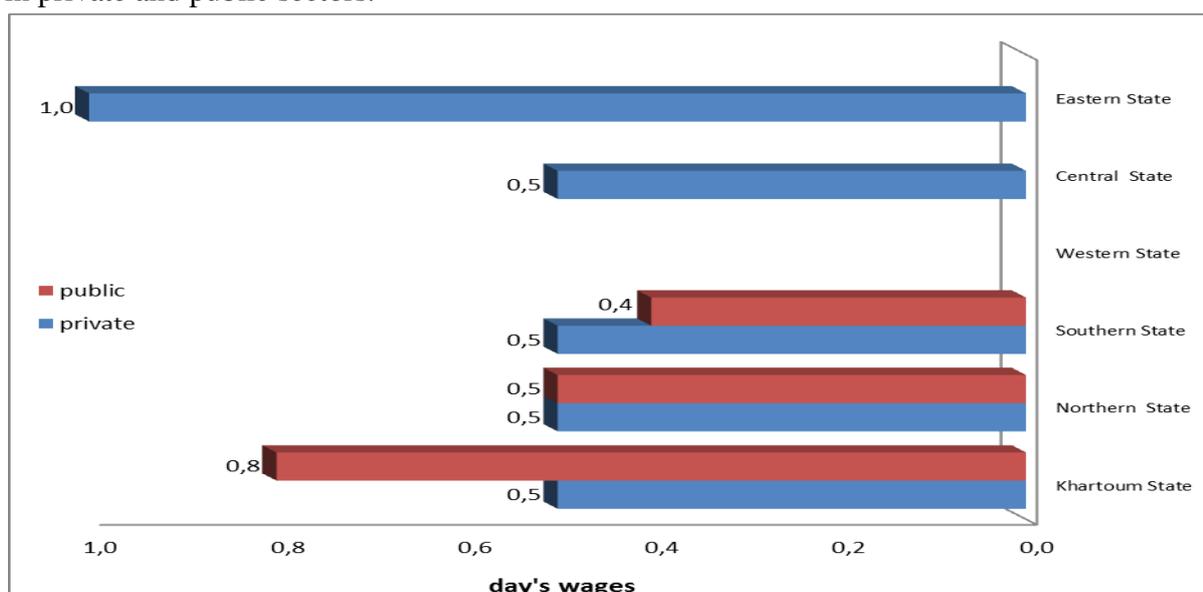
	Lowest priced	Lowest priced	Originator
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	generic - public sector	generic - private sector	brand-private sector
<b>Father - atenolol</b>	0.4	0.4	3.4
<b>Child – beclomethosone inhaler</b>	1.4	1.4	
<b>Mother- amoxicillin + clavulanic acid 500+125 mg tabs</b>	2.2	2.3	4.2
<b>Total days' wages for one month treatment</b>	4.0	4.1	7.6

Comparing our study results with 2005 we found there is was decrease in the number of day's wages needed to treat asthma with originator brand Salbutamol 100 mcg/dose inhaler from 2.6 days' wages in 2005 to 1.7 days' wages in 2012, and in the private sector from 2.6 days' wages in 2005 to 2.1 days' wages in 2012. For LPGs in the private sector, affordability improved from 1.2 days' wages in 2005 to 0.6 days' wages in 2012. It must be remembered that the LPG would be far more affordable than the originator brand. While there was a decrease in the number of day's wages needed to treat hypertension with originator brand Atenolol 50 mg tab from 5.3 days' wages in 2005 to 3.4 days' wages in 2012, in both years this product was unaffordable. For LPGs of Atenolol there was a modest improvement in affordability in the public sector (from 0.6 days' wages in 2005 to 0.4 days' wages in 2012) and private sector (from 0.7 days' wages in 2005 to 0.4 days' wages in 2012).

Figure (8) illustrates the treatment affordability in different regions in Sudan for lowest-priced generic Glibenclamide 5 mg cap/tab x 30 days to treat diabetes. The government worker will need half a days' wages in most of the regions (in both public and private sectors) except in the public sector in Khartoum state (0.8 day's wages) and in the private sector in Eastern state (one day's wage).

**Figure 8:** Affordability of lowest priced generics of Glibenclamide to treat diabetes by region, in private and public sectors.



### 3.4. Cross- sector medicines prices comparisons and price variation

This section deals with a comparison of availability and medicine prices among different sectors.

#### 3.4.1. Availability comparisons between sectors

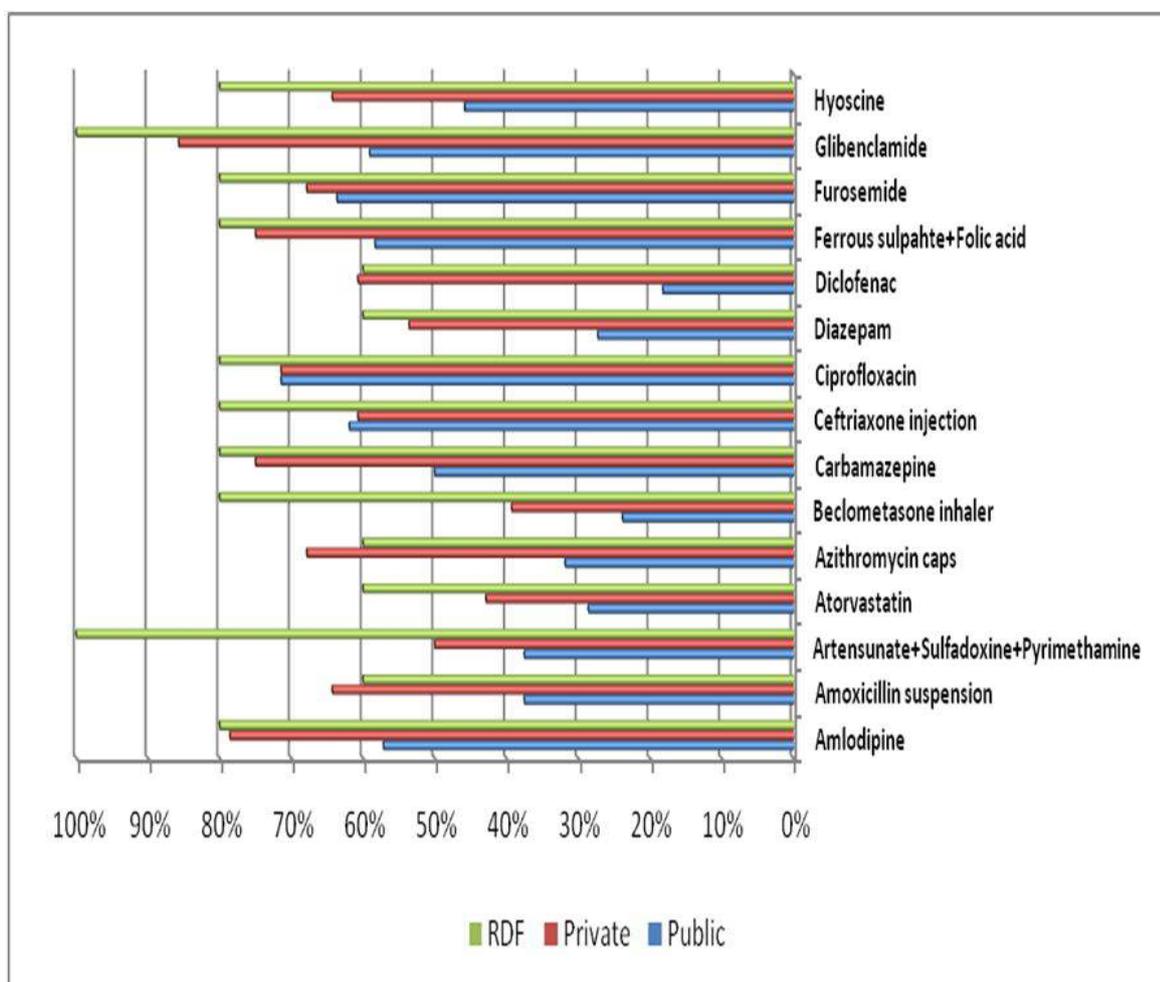
Mean medicine availability in the different sectors is shown in table (22).

**Table 22:** Shows cross-sector medicine availability comparison.

	Mean Percent Availability		
	Public Sector (n=24 outlets)	Private Sector (n=28 outlets)	RDF Sector (n=5 outlets)
Originator brand	1.8%	9.3%	1.6%
Lowest priced generic	39.5%	56.6%	60.0%

From the table we can see that the public sector outlets and RDF pharmacies had the lowest availability for originator brands (OB). For lowest priced generics, the public sector had the lowest mean availability compared to the other sectors.

**Figure 9:** Inter-sector availability comparison of some selected LPGs



### 3.4.2. Cross-sector Comparisons of Medicine Prices

Cross-sector comparisons of patient prices were done for all sectors, and comparisons between the sectors were based on medicines with prices found in both sectors (matched pairs).

#### A. Public sector/ Private sector Comparison:

Patient prices of originator brand medicines were 19.1 % higher in the private sector compared to the public sector, however, there were only 3 medicines in the analysis. Lowest-priced generics were 14.6% higher priced in the private sector compared to the public sector, across 41 medicines as shown in table (23).

**Table 23:** Patient prices differences at the public sector compared to the private sector

	<b>Comparisons of Median MPRs for Medicines With Prices in Both Sectors</b>			
	<b>Public Sector (n=24 outlets)</b>	<b>Private Sector (n=28 outlets)</b>	<b>No of medicine in both sectors</b>	<b>% difference private to public</b>
Originator brand	8.03	9.57	3	19.1%
Lowest priced generic	2.99	3.43	41	14.6%

#### B. Public sector/ RDF sector Comparison:

Originator brand medicines were 14.7 % lower priced in the RDF sector compared to the public sector, however this was based on only 2 medicines. Lowest-priced generics were 51.9% higher priced in the RDF sector compared to the public sector as shown in table (24).

**Table 24:** Patient price differences at the public sector compared to the RDF sector outlets.

	<b>Comparisons of Median MPRs for Medicines With Prices in Both Sectors</b>			
	<b>Public Sector (n=24 outlets)</b>	<b>RDF Sector (n=5 outlets)</b>	<b>No of medicine in both sectors</b>	<b>% difference RDF to public</b>
Originator brand	12.65	10.80	2	- 14.7%
Lowest priced generic	3.53	5.36	38	51.9%

#### C. Public sector/ NGO sector Comparison:

Lowest-priced generics were 20.9% higher priced in the NGO sampled compared to the public sector as shown in table (25).

**Table 25:** Prices differences at the public sector outlets compared to the NGO sector.

	<b>Comparisons of Median MPRs for Medicines With Prices in Both Sectors</b>			
	<b>Public Sector (n=24 outlets)</b>	<b>NGO Sector (n=1 outlet)</b>	<b>No of medicine in both sectors</b>	<b>% difference NGO to public</b>
Originator brand	3.14	4.58	1	45.9%
Lowest priced generic	4.10	4.96	31	20.9%

**D. Procurement prices /Public sector patient price comparison:**

As shown in table (26), across 23 lowest-priced generics, the CMS was selling medicines to patients at 150.6% more than they procured them.

**Table 26:** Procurement sector tender prices compared to public sector patient prices.

	<b>Comparisons of Median MPRs for Medicines With Prices in Both Sectors</b>			
	<b>Procurement Sector (n=1 outlets)</b>	<b>Public Sector (n=24 outlets)</b>	<b>No of medicine in both sectors</b>	<b>% difference public/ procurement</b>
Originator brand	1.88	3.14	1	66.7%
Lowest priced generic	1.08	2.7	23	150.6%

A comparison of the CMS selling prices for lowest-priced generics compared to public sector patient prices showed that patients pay 26.4% more than the CMS selling price as shown in table (27).

**Table 27:** Prices differences at the Procurement sector - CMS-selling prices compared to the public sector outlets selling prices.

	<b>Comparisons of Median MPRs for Medicines With Prices in Both Sectors</b>			
	<b>Procurement Sector (n=1 CMS selling outlets)</b>	<b>Public Sector (n=24 outlets)</b>	<b>No of medicine in both sectors</b>	<b>% difference public/ procurement - CMS</b>
Originator brand	0	0	0	0
Lowest priced	2.23	2.93	23	26.4%

generic				
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### E. Private sector / RDF sector Comparison:

Originator brand medicines were 25.4 % lower priced in the RDF sector than in the private sector (based on only 2 medicines) but lowest-priced generics were 34% higher priced in RDF outlets as shown in table (28).

**Table 28:** Patient price differences in the private sector compared to the RDF sector.

	Comparisons of Median MPRs for Medicines With Prices in Both Sectors			
	Private Sector (n=28 outlets)	RDF Sector (n=5 outlets)	No of medicine in both sectors	% difference RDF to private
Originator brand	14.47	10.8	2	-25.4%
Lowest priced generic	4.14	5.55	46	34.0%

### F. Private sector / NGO sector Comparison

There was little difference in patient prices of originator brand medicines prices (0.4 %) between the NGO sector and the private sector, but lowest-priced generics were higher prices in the NGO outlet by 11% as shown in table (29).

**Table 29:** Prices differences at the private sector compared to the NGO sector outlets.

	Comparisons of Median MPRs for Medicines With Prices in Both Sectors			
	Private Sector (n=28 outlets)	NGO Sector (n=1 outlet)	No of medicine in both sectors	% difference private to NGO
Originator brand	5.11	5.09	3	-0.4%
Lowest priced generic	4.50	5.01	34	11.0%

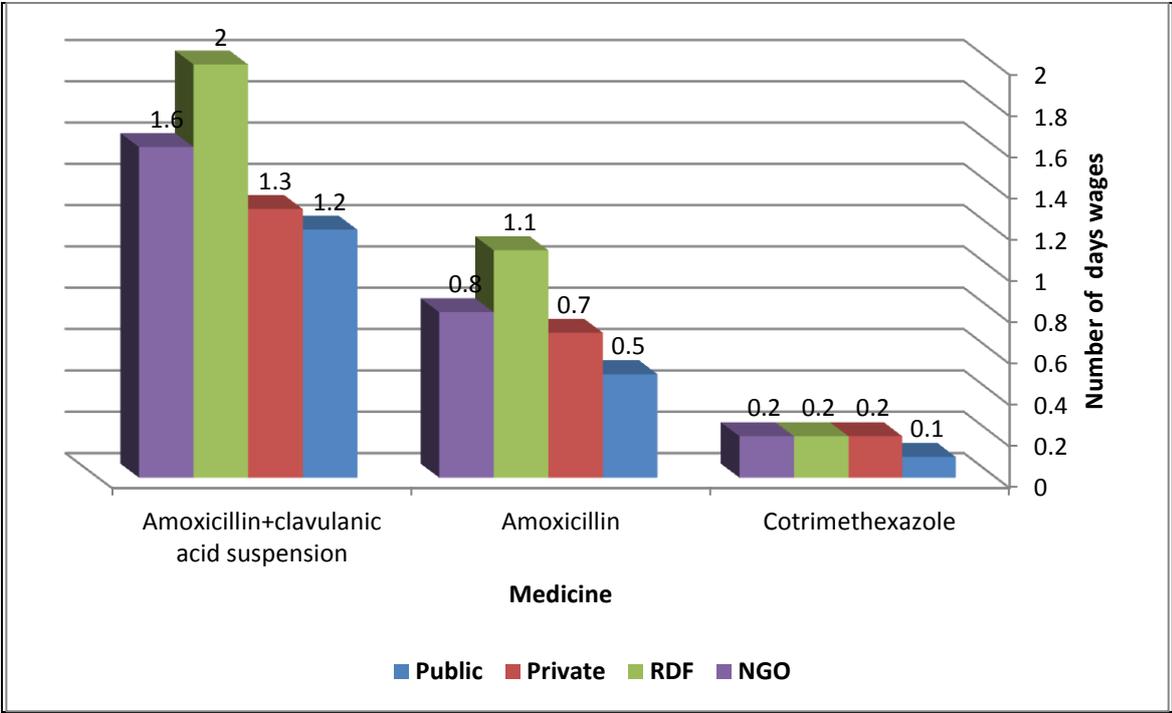
### 3.4.3 Cross- sector Comparisons of Affordability of Medicines

Cross-sector affordability comparisons of generics were done in all sectors where patients paid for medicines out of pocket (Public, private, RDF, NGO). Comparisons between the sectors were based on medicines with day's wages matched in all above sectors. The following findings were observed as per figures below.

Some generic medicines were more affordable in the public sector than private, RDF and NGO and this include medicines used for management of paediatric respiratory tract infections (Co-trimoxazole and Amoxicillin + clavulanic acid) and adult respiratory tract infection

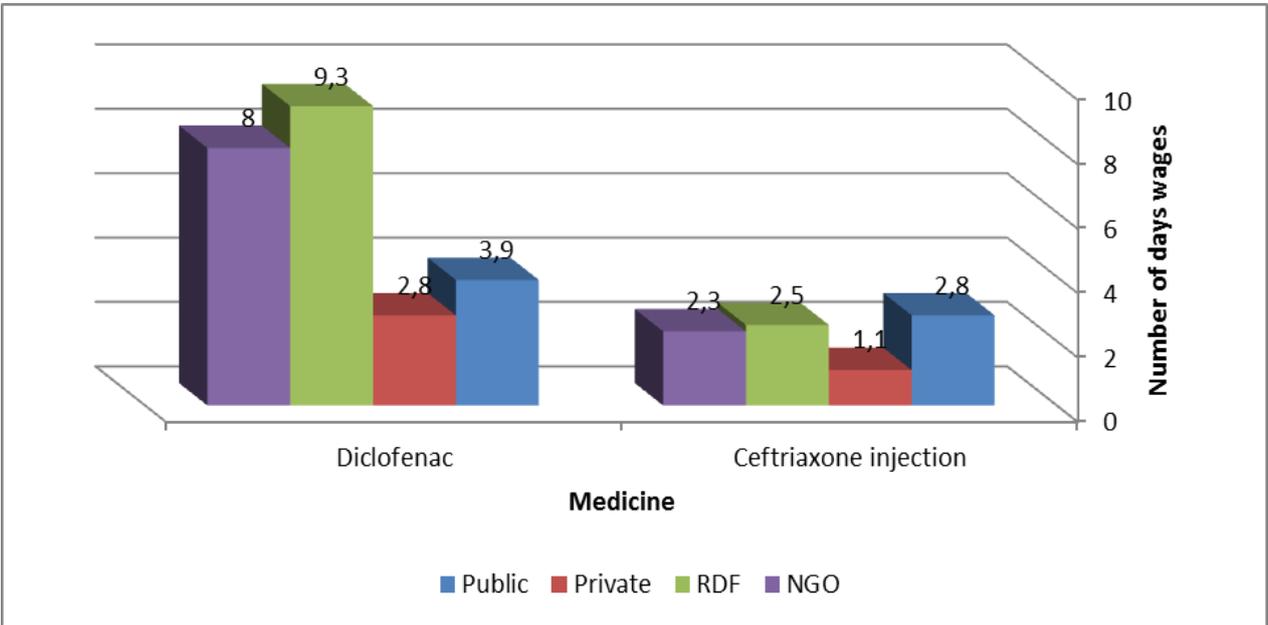
(Amoxicillin) as shown in figure (10).

**Figure 10:** Cross-sector comparison of affordability for some lowest priced generics illustrating improved affordability in the public sector.



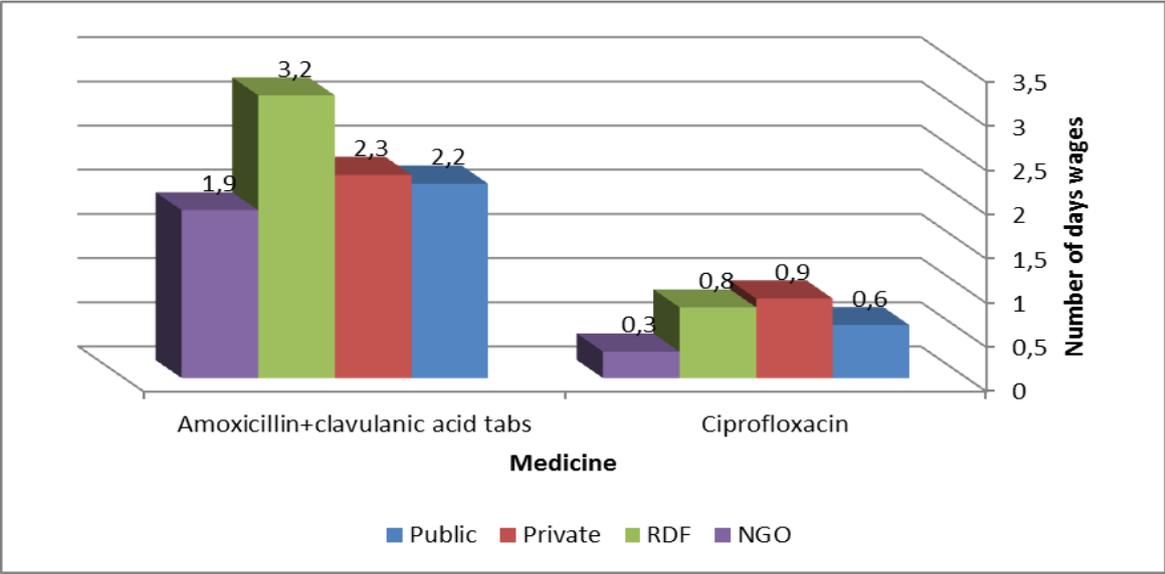
Some generic medicines were more affordable in the private sector than in the public, RDF and NGO sectors. This include medicines used for management of adult respiratory tract infection (Ceftriaxone injection) and arthritis (Diclofenac) as shown in figure (11). However, it is clear that diclofenac was not affordable in any sector.

**Figure 11:** Cross-sector comparison of affordability for some lowest-priced generic illustrating improved affordability in the private sector.



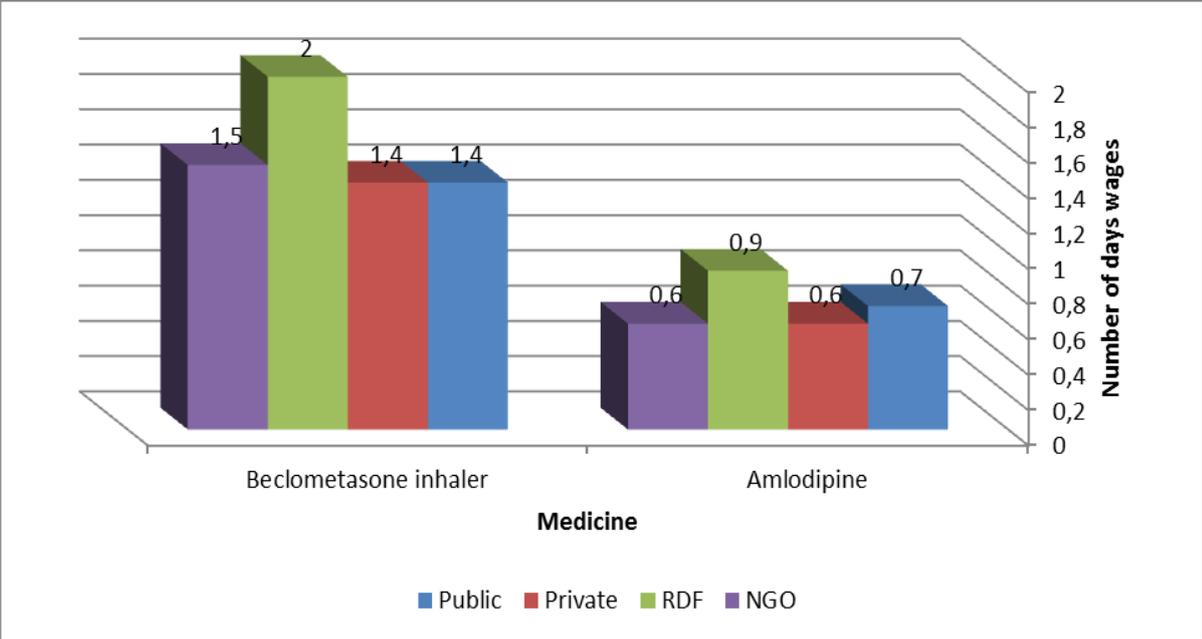
Some generic medicines were more affordable in the NGO sector than in the public, private and RDF sectors. This includes medicines used for management of adult respiratory tract infection (Ciprofloxacin and Amoxicillin + clavulanic acid tabs as shown in figure (12). However, it must be noted that amoxicillin+clavulanic acid may not be affordable in any sector.

**Figure 12:** Cross-sector comparison of affordability for some lowest-priced generic illustrating improved affordability in the NGO sector



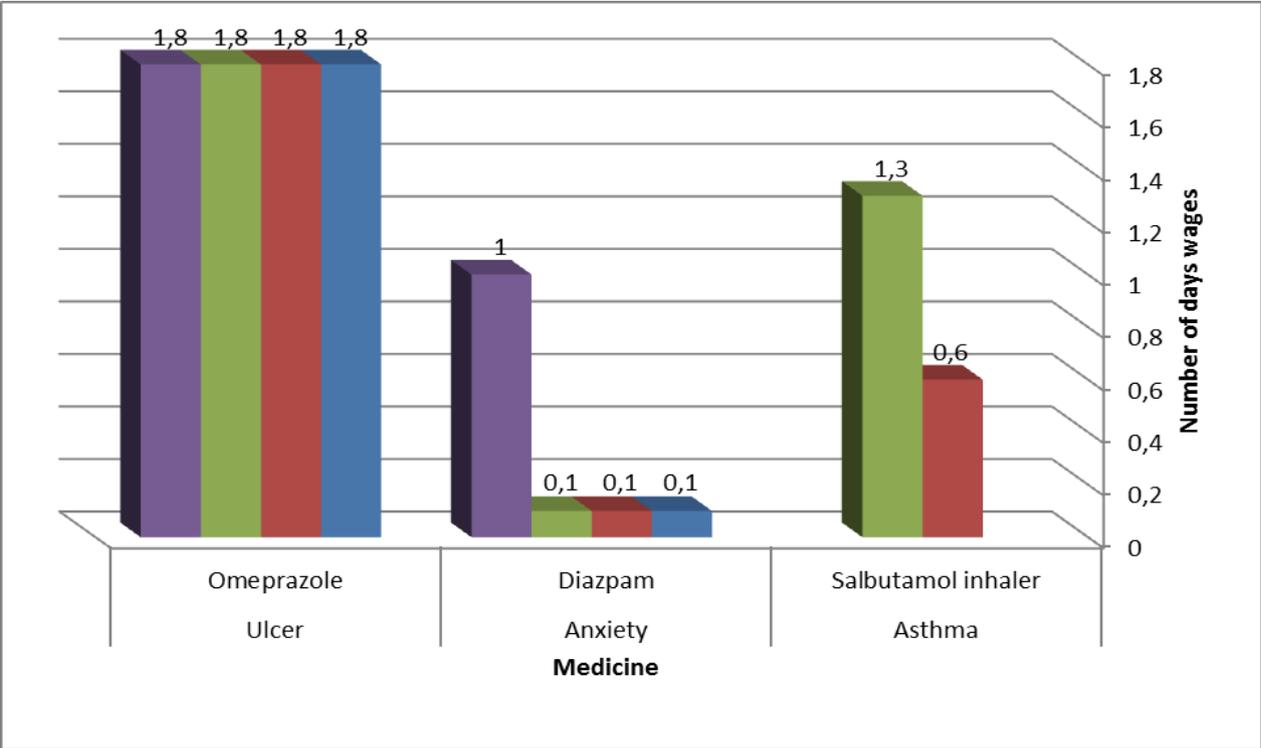
On the other hand, some lowest-priced generic medicines were less affordable in the RDF sector than in the public, private and NGO sectors e.g. Amlodipine used for management of hypertension and Beclomethasone inhaler for asthma as shown in figure (13).

**Figure 13:** Cross-sector comparison of affordability for some lowest-priced generic illustrating poor affordability in the RDF sector.



Medicines found to be unaffordable in any sector is of particular concern as shown for omeprazole in figure (14).

**Figure 14:** Cross-sector comparison of some lowest-priced generics showing equal affordability/unaffordability.



**3.5. The cumulative add-ons and mark-ups**

In Sudan there are legal /regulatory provisions affecting pricing of medicines by determination of medicines C& F prices upon their registration and costing after importation. These regulations are aimed at the level of manufacturers, wholesalers and retailers. The C& F pricing is based on many factors such as comparisons between generics and registered originators, and prices in other countries. The C&F prices are published periodically as Sudan index and available at their website<sup>16</sup>. There are also legal provisions requiring importation of medicines through authorized ports of entry and provisions that importers, wholesalers and pharmacies be licensed. Wholesalers are required to submit to NMPB for costing after importation for each order, and unless they obtain approval they not allowed distribute the medicines.<sup>15</sup>

**3.5.1. Mark-up % contribution and cumulative % for procurement sectors**

We tracked prices for 5 medicines from purchasing to the wholesale selling price to the retail price from CMS and 10 medicines from the RDF. As it is difficult to track back price as per WHO/HAI methodology because there was no transparency in the availability of mark-up data

from CMS and RDF we did it another way around as shown in tables (30) & (31). The findings show that:

- 1) Competitive procurement prices from CMS and RDF do not appear to be passed on to patients. The average total mark-up for medicines procured from the CMS was 90% (ranged from 83% for Gentamicin injection to 104% for Co-trimoxazole suspension). Similarly the RDF average was 164% (ranged from 49.4% for Atenolol to 320% for Amoxicillin caps) reflecting a higher mark-up than CMS.
- 2) Mark-ups added on tender awarded prices to get the selling price averaged 70% and 123% for CMS and RDF respectively.
- 3) The average retail prices were within the official profit for CMS public pharmacies (20%) while it was double the official profit for RDF pharmacy outlets (41%).

Also percentage of mark-ups and contribution were analyzed as per WHO/HAI methodology for 3 medicines procured through CMS (figures 15 –17, tables 32-33) and for 2 medicines through RDF (figures 19 & 20, table 34).

### **3.5.2. Mark-up for private sectors**

To understand the pricing structure in the private sector, we analysed medicine prices in terms of price components for 3 of the survey medicines. To obtain more specific information, a collection of some local agents costing documents were reviewed for prices of medicines bought and sold in the private sector. Our goal was to find current price component data and to determine whether price components contribute towards high medicine prices in Sudan.

The WHO/HAI methodology defines the following stages in the distribution chain:

**Stage 0:** Manufacturer's Selling Price (MSP).

**Stage 1:** Stage 1 of the component cost includes I&F (Insurance and Freight).

**Stage 2:** includes port charges, and quarantine charges (after the arrival of medicines in the country). Letter of Credit (LC) charges are included in the finance and banking fees = 13% as per recent NMPB costing equation<sup>#</sup>

**Stage 3:** Distributor's/Wholesaler's Mark-Up = 15% in Sudan.

**Stage 4:** Retailers' and pharmacies' mark-ups = 20% in Sudan.

<sup>#</sup>Retail price (RP) = CIF (in \$) X Exchange rate X 1.13 X 1.15 X 1.2

Where 1.13 = port and clearance fees, 1.15 = importer profit and 1.2 = Retailer profit

**Stage 5:** Value Added Tax (VAT) - there is no VAT for medicines in Sudan.

Figures (18, 21 & 22) and tables (33 & 35) were used to describe all price components apart from the MSP for private sector.

Comparing our price component analysis with 2005 survey we found that total mark-ups had decreased from 54.5% in 2005 to 48% in 2013 as some fees were abolished such as customs duty (5%) and the Ministry of Defence stamp (1%).

**Table 30:** Mark-up analysis from CMS to patients, public sector, for some surveyed medicines:

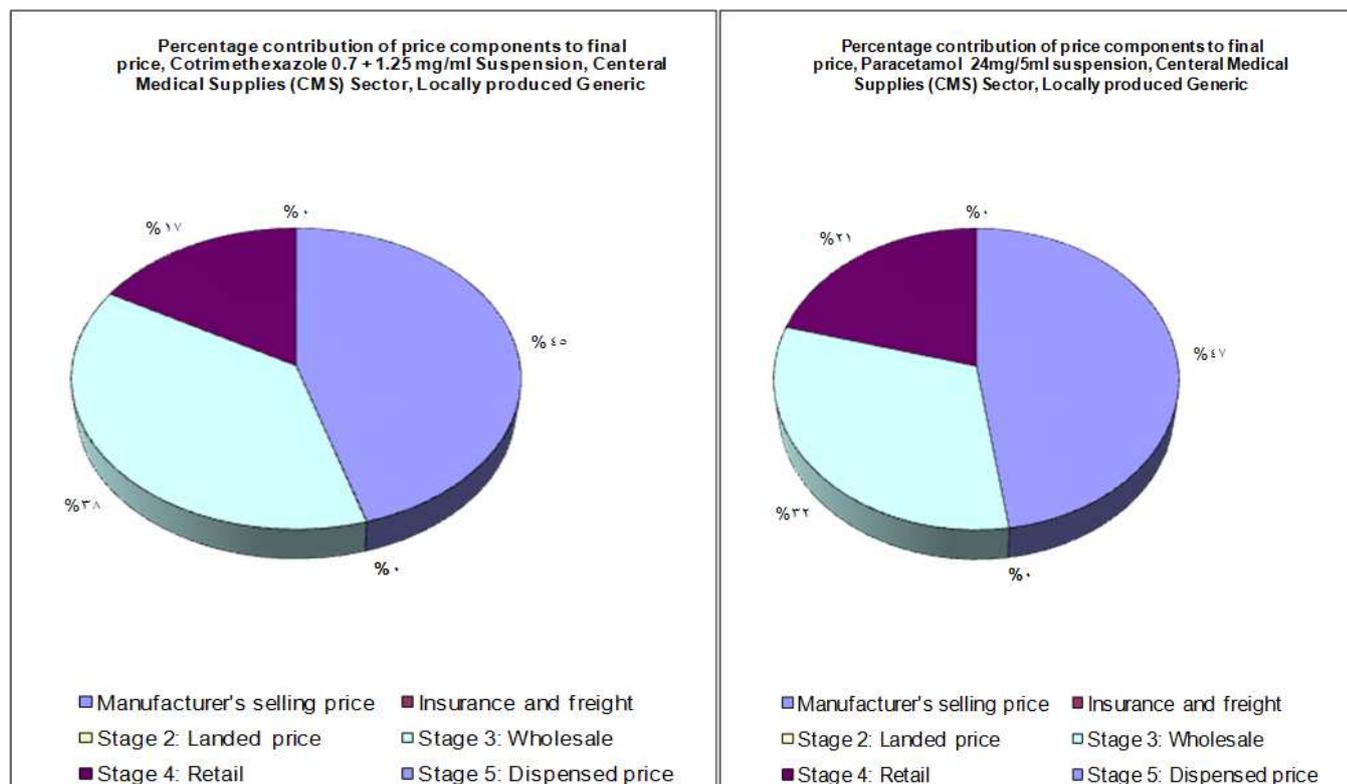
Medicine Name	Procured price per unit	Selling price to public pharmacy	% Mark-up	Retail price for the patient	% Mark-up	TOTAL % of mark-ups
Azithromycin dry powder	0.15	0.27	75%	0.3	11%	86%
Co-trimoxazole suspension	0.0136	0.025	84%	0.03	20%	104%
Furosemide	0.07	0.13	85%	0.15	15%	100%
Gentamicin injection	0.25	0.37	48%	0.5	35%	83%
Hyoscine	0.11	0.18	64%	0.2	11%	75%
Paracetamol suspension	0.02	0.0333	67%	0.042	26%	93%
<b>Average Mark-ups %</b>			<b>70%</b>		<b>20%</b>	<b>90%</b>

**Table 31:** The Mark-up analysis from RDF to patients for some surveyed medicines

Medicine Name	Procured price per unit	Selling price to public pharmacy	% Mark-up	Retail price for the patient	% Mark-up	TOTAL % of mark-ups
Amoxicillin	0.125	0.5	300%	0.6	20%	320%
Amoxicillin+clavulanic acid suspension	0.095	0.245	158%	0.285	16%	174%
Atenolol	0.166	0.17	2.4%	0.25	47%	49.4%
Beclometasone inhaler	0.06	0.08	33%	0.1185	48%	81%
Ciprofloxacin	0.183	0.5	173%	0.72	44%	217%
Erthyromycin	0.156	0.36	131%	0.4	11%	142%
Ferrous sulphate+Folic acid	0.14	0.25	79%	0.57	128%	207%
Hyoscine	0.08	0.2	150%	0.24	20%	170%

<b>Omeprazole</b>	0.226	0.57	152%	0.71	25%	177%
<b>Salbutamol inhaler</b>	0.0336	0.05	49%	0.075	50%	99%
<b>Average Mark-ups</b>			<b>123%</b>		<b>41%</b>	<b>164%</b>

**Figures (15 & 16):** Contribution of different stages to patient prices when procured via CMS



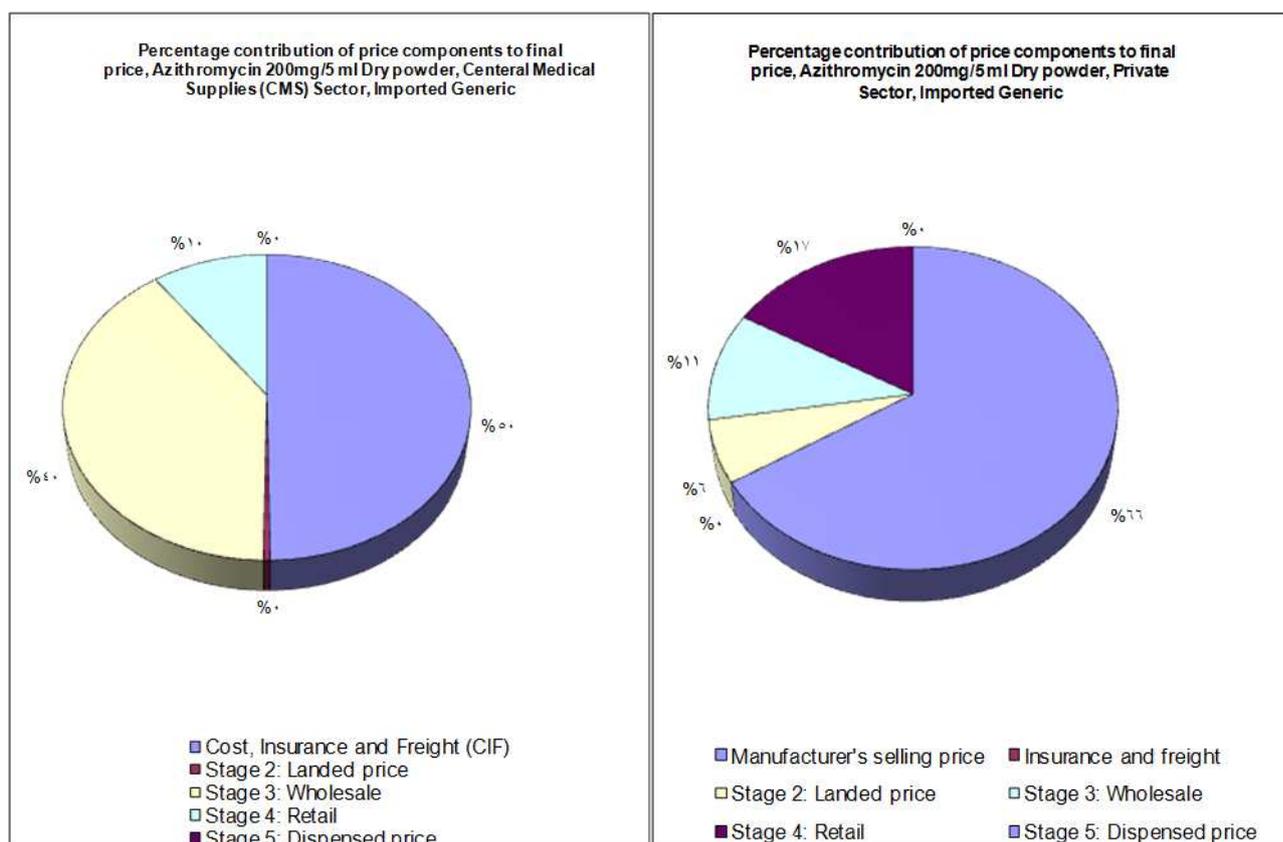
**Table 32:** Examples of the mark-ups of different stages to the final patient prices for medicines locally produced and imported, procured by CMS.

Sector	Central Medical Supplies (CMS)	Field data Paracetamol Generic	Field data Co-trimoxazole Generic	Field data Azithromycin Generic
	Import/local	Locally produced	Locally produced	Imported
Region	Data	% of Mark-up by stage		
Urban	MSP	1.20	1.36	4.5
	Stage 1 Mark-up	0.00%	0.00%	0.00%
	Stage 2 Mark-up	0.00%	0.00%	1.00%
	Stage 3 Mark-up	66.5%	83.82%	79.21%
	Stage 4 Mark-up	26.3%	20.00%	11.05%
	Stage 5 Mark-up	0.00	0.00%	0.00%
	Cumulative Mark-up	110.00%	120.59%	101.00%

	Final price	2.52	3.00	9.05
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MSP was found to be about 45%-47% of the final patient price (Figures 15 & 16) Cumulative mark-ups were 110%, 120.59% and 101 for Paracetamol, Co-trimoxazole and Azithromycin with the largest being the mark-up charged by the CMS (stage 3) at 67% - 84% (Table 32 ).

**Figures (17 & 18):** Contribution by stage to the final patient price CMS procured and private



**Table 33: Comparison of Azithromycin Mark-ups between CMS and private sectors**

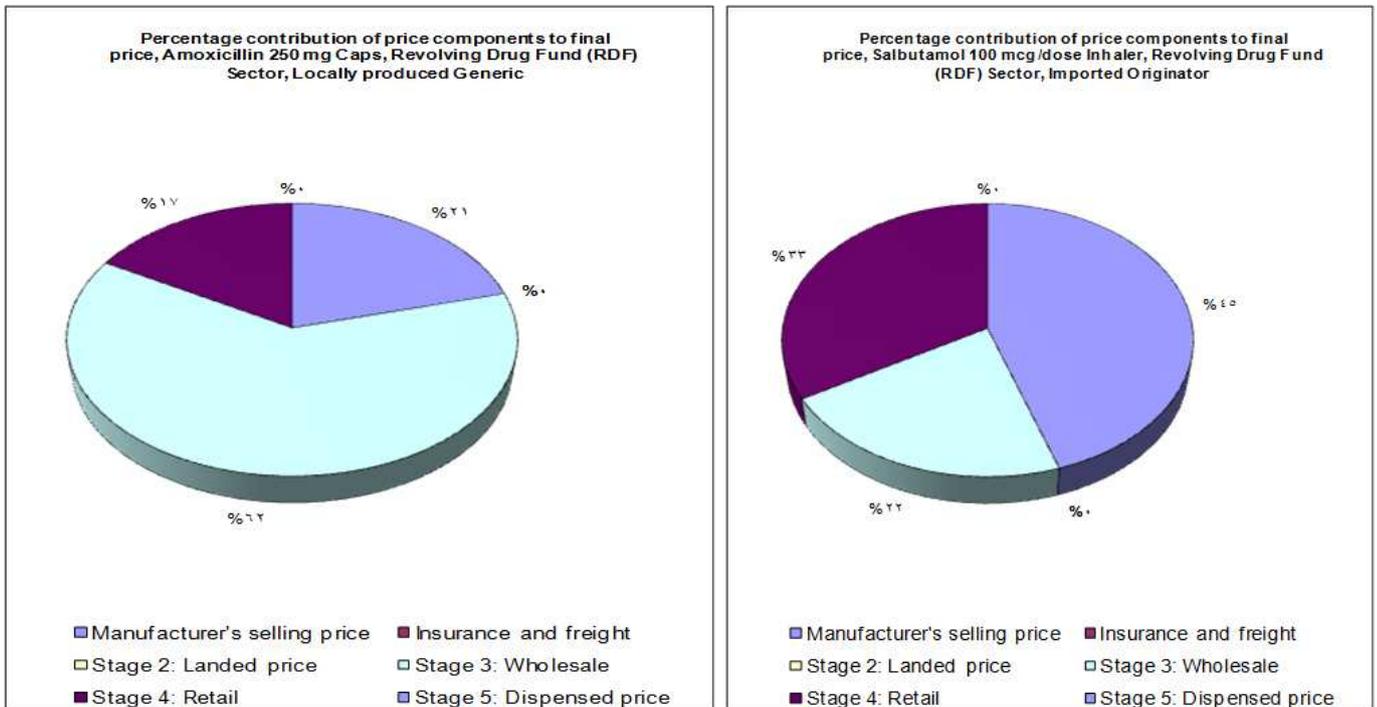
Sector		Central Medical Supplies (CMS)			Private		
Import/local	Imported	Azithromycin			Azithromycin		
		Generic			Generic		
		Field data			Field data		
Region	Data	Mark-up	Contribution %	Value (SDG)	Mark-up	% Contribution	Value (SDG)
Urban	CIF contribution		49.75%	4.50		66.16%	20.36
	Stage 1 contribution	0.00%	0.00%	0.00	0.00%	0.00%	0.00
	Stage 2 contribution	1.00%	0.50%	0.04	9.53%	6.31%	1.94
	Stage 3 contribution	79.21%	39.80%	3.60	15.00%	10.87%	3.34
	Stage 4 contribution	11.05%	9.95%	0.90	20.00%	16.67%	5.13
	Stage 5 contribution	0.00%	0.00%	0.00	0.00%	0.00%	0.00
	Total cumulative mark-up	101.00%			51.16%		

	up						
	Final price			9.05			30.77

The previous figures and table compared the C&F price, cumulative mark-up, stage contributions percentage and final price of the identical product from the same source and you can observe the following:

- 1) Low CIF price of CMS compared to private sector for the same product.
- 2) Higher contribution of CIF to final patient price in private sector (66.16%) than CMS (49.75%).
- 3) The CMS mark-up was more than 5 times that of private sector (79.21% vs 15%).
- 4) The cumulative mark-up for the product procured by CMS was almost doubled that of private sector (100.1% vs. 51.16% respectively).
- 5) However, the patient at final paid significantly less for the product when purchased through the CMS than private sector (almost third final price).

**Figures (19& 20):** Examples of the contribution of different stages to patient prices, procured by RDF

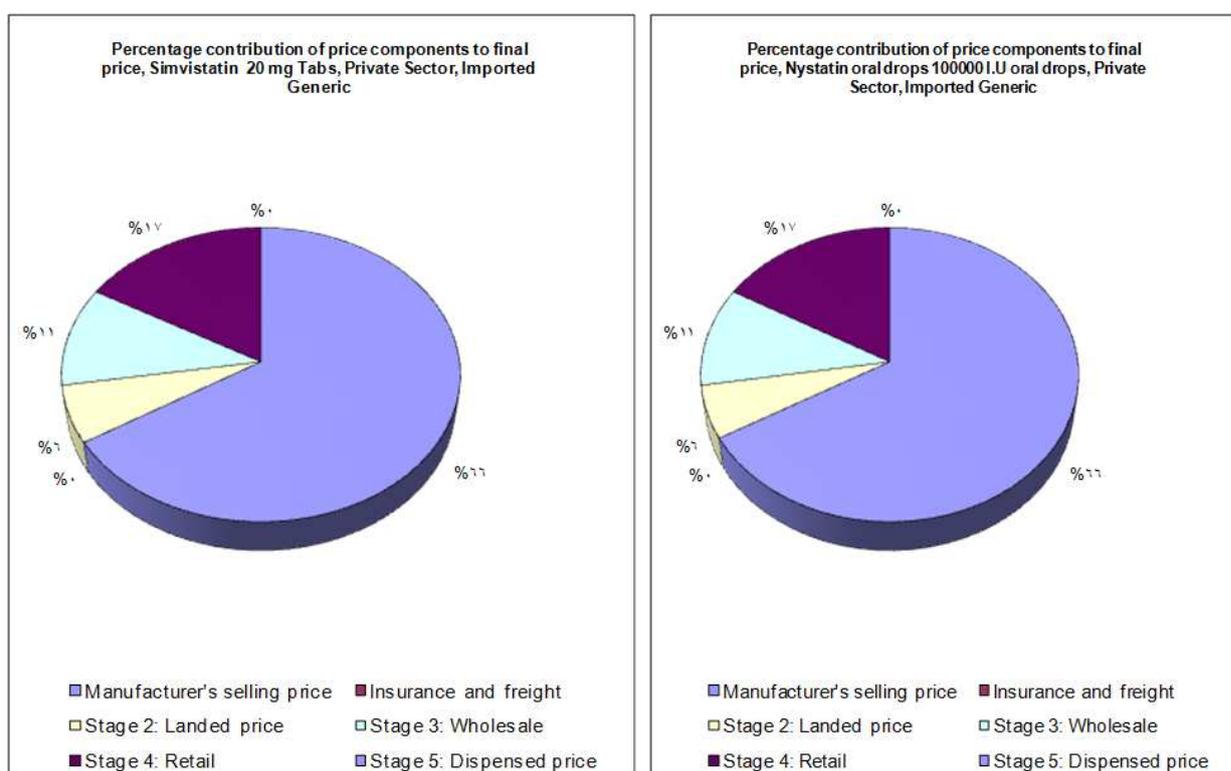


**Table 34:** Examples of the percentage contribution of each stage to final patient price, RDF sector.

Sector	Revolving Drug Fund (RDF)		Amoxicillin Generic Field data		Salbutamol Originator Field data		
Region	Import/local	Data	% contribution	Value (SDG)	% contribution	Value (SDG)	
Urban	Imported	CIF contribution			44.80%	6.72	
		Stage 1 contribution			0.00%	0.00	
		Stage 2 contribution			0.00%	0.00	
		Stage 3 contribution			21.87%	3.28	
		Stage 4 contribution			33.33%	5.00	
		Stage 5 contribution			0.00%	0.00	
		Final price				15.00	
	Locally produced	MSP contribution		20.83%	2.00		
		Stage 1 contribution		0.00%	0.00		
		Stage 2 contribution		0.00%	0.00		
		Stage 3 contribution		62.50%	6.00		
		Stage 4 contribution		16.67%	1.60		
		Stage 5 contribution		0.00%	0.00		
		Final price			9.60		

The above figures and table show comparison between originator and locally produced items procured and sold by RDF, we can observe the high MSP/CIF contribution for originator (44.8%) compared to locally produced (20.83%). The cumulative mark-ups were 380% for amoxicillin and 123% for Salbutamol. The RDF mark-up was 300% and 49% respectively.

**Figures (21 & 22): Private sector cumulative % contribution**



**Table 35: Contribution % to final patient price in the private sector**

Sector			Private Nystatin oral drops Generic Field data		Private Simvastatin Generic Field data	
Region	Import/local	Data	% Contribution	Value (SDG)	% Contribution	Value (SDG)
Urban	Imported	MSP/CIF contribution	66.66%	3.51	66.16%	26.33
		Stage 1 contribution	0.00%	0.00	0.00%	0.00
		Stage 2 contribution	5.80%	0.31	6.31%	1.94
		Stage 3 contribution	10.87%	0.57	10.87%	3.34
		Stage 4 contribution	16.67%	0.88	16.67%	5.13
		Stage 5 contribution	0.00%	0.00	0.00%	0.00
		Final price		5.27		39.79

The above figures and table show the contribution of each stage to the patient price for 2 different medicines imported from 2 different manufacturing companies. Note this is hypothetical data.

### 3.6. Medicines prices in Sudan from international perspectives

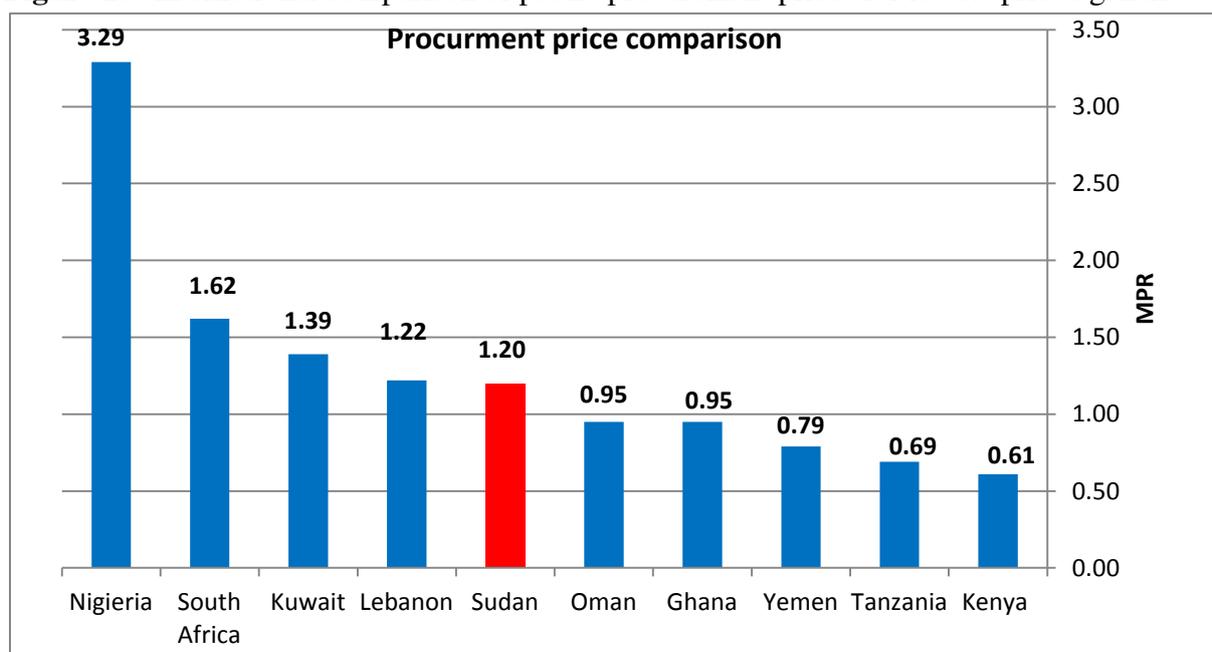
Price, availability and affordability comparisons of the medicines have been made between Sudan and of a group of countries who have conducted surveys using the WHO/HAI methodology and shared the same characteristics in terms of pharmaceutical regulatory, economic indicator and/or development. As Sudan is classified as an African and Mediterranean country we selected 5 African and 5 Mediterranean Arabian countries to be compared. The African countries surveyed data compared to Sudan (2012) were Ghana (2004), Kenya (2004), Nigeria (2004), South Africa (2004), Tanzania (2012). Arabian countries included were Jordan (2004), Kuwait (2004), Lebanon (2004), Oman (2007), Yemen (2006). Country data were obtained from the global database of survey results available on the HAI website: <http://www.haiweb.org/medicineprices>.

**Note:** surveys included different baskets of medicines; prices were not adjusted for inflation/deflation nor were private sector prices adjusted for purchasing power parity. However, the findings from these comparisons should be used with caution.

#### 3.6.1. International comparisons of public sector procurement

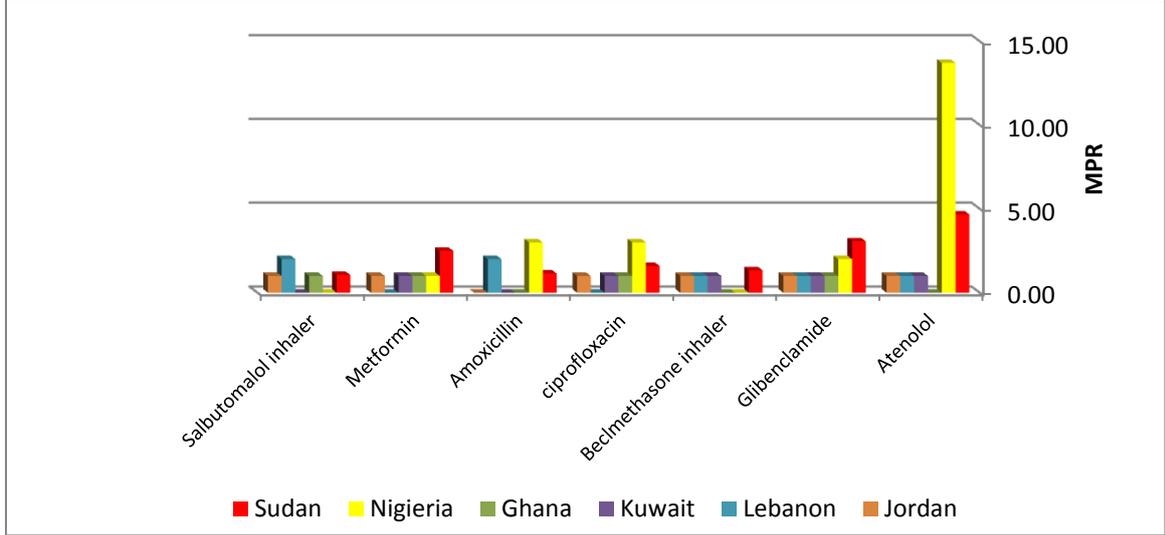
Results for median MPRs for procurement prices of lowest-priced generics showed that government procurement prices in Sudan (2012) were higher than some countries and lower than found in others. Overall, Sudan's public sector appears to be purchasing medicines less efficiently than 5 countries, and more efficiently than the other 4 countries (Figure 23).

**Figure 23:** International comparison of public procurement prices for lowest priced generic



Comparison of 5 individual medicines for procurement MPR could be made between Sudan and 5 from 10 countries selected as shown in (Fig 24)

**Figure 24:** International comparison of public procurement prices for selected lowest priced generics



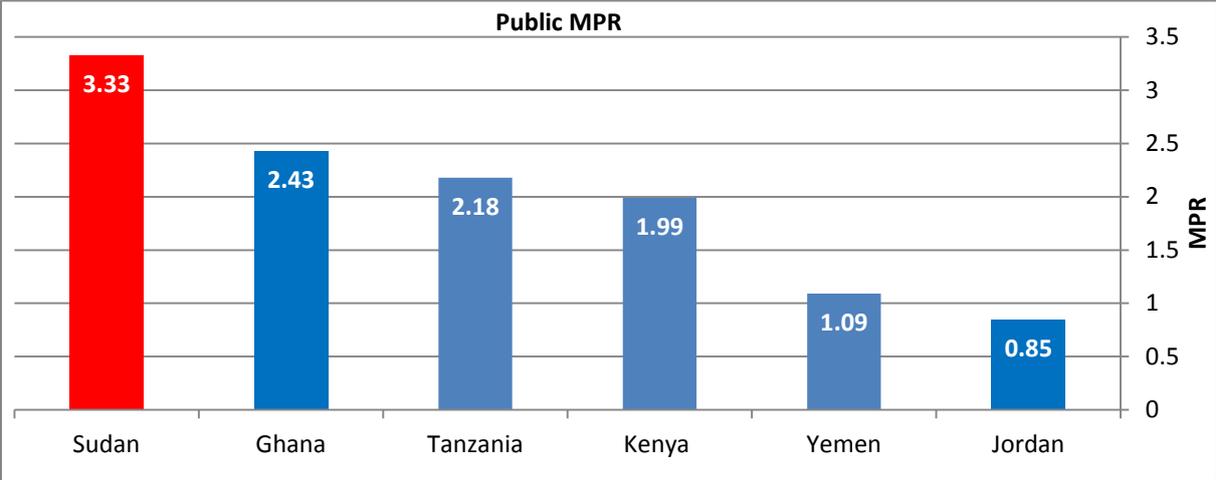
For originator brands it was only possible to compare Sudan procurement prices with 4 of the countries. The findings showed that Sudan had an MPR for OB = 1.88 which is more efficient than MPRs for Kuwait (2.69), Oman (5.8), Lebanon (5.92), while it was less efficient than South Africa MPR (1.64).

**3.6.2. International comparisons of public sector patient prices**

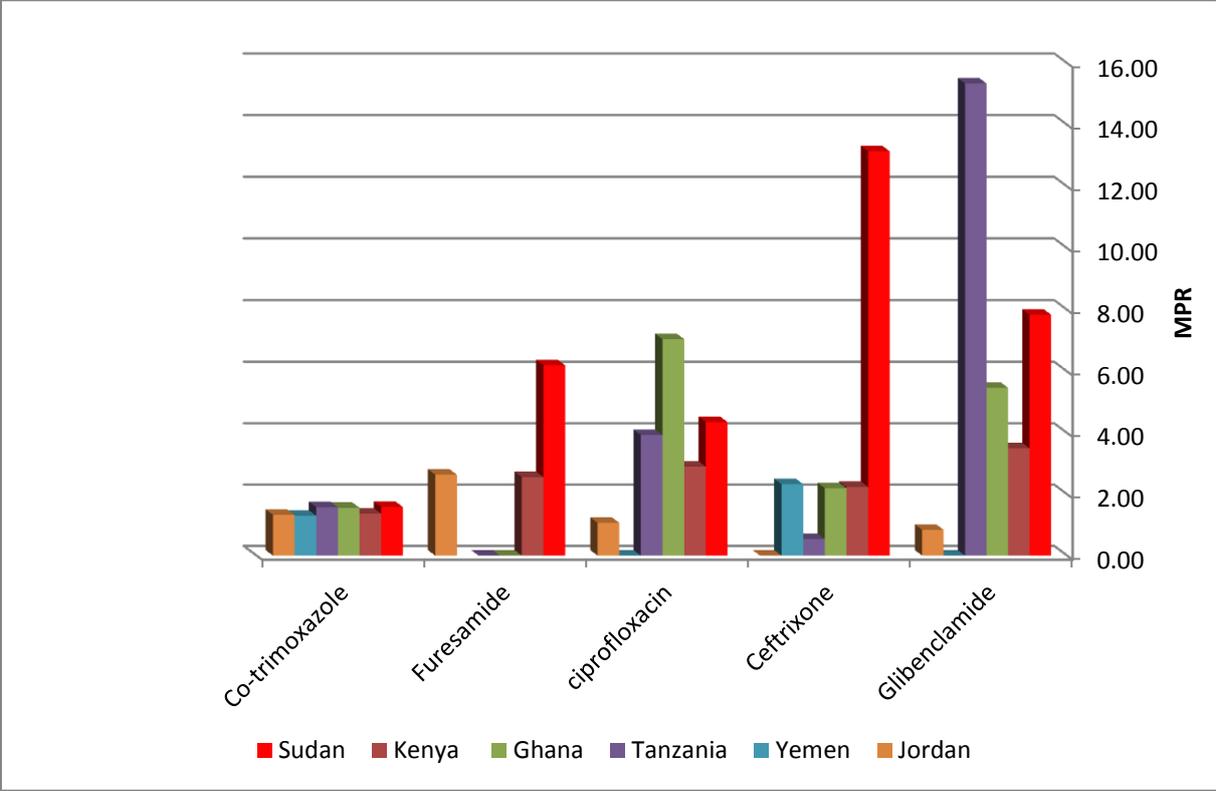
Results for public sector patient MPRs for lowest-priced generics were possible for 5 out of the 10 countries. Patient prices in the public sector in Sudan (2012) were the highest among five countries as shown in (Figure 25).

Comparisons for 4 individual medicines (lowest-priced generics) are shown in (Fig 26):

**Figure 25:** International comparison of public sector patient prices for lowest priced generics



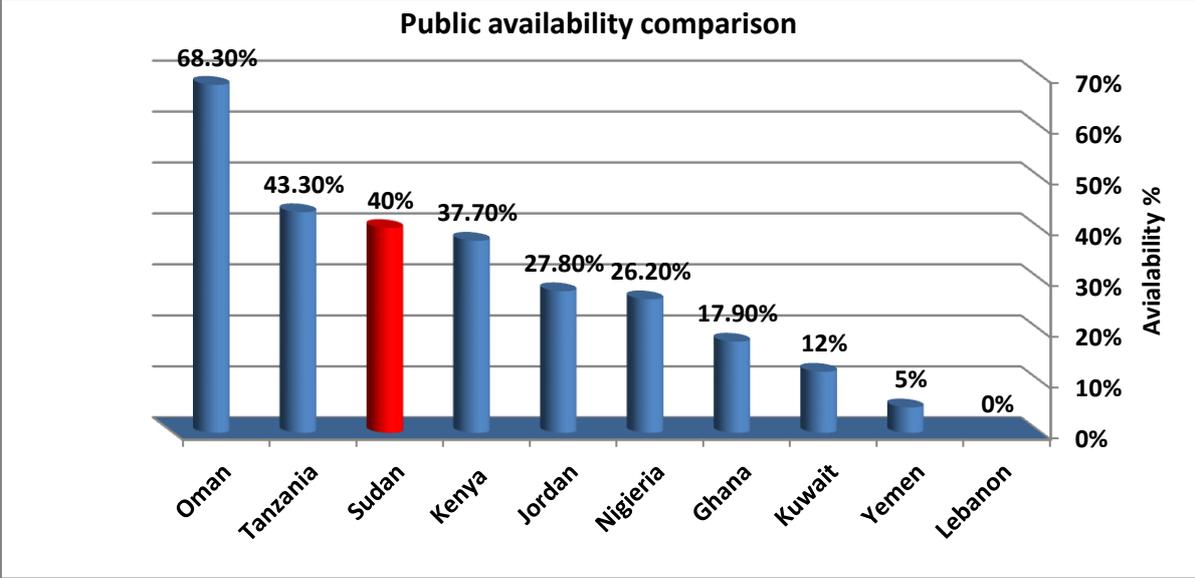
**Figure 26:** International comparison of LPG patient prices, public sector



For originator brands, public sector patient prices were higher in Sudan (MPR 8.03) than in Tanzania (3.61), Jordan (5.95) and Ghana (14.9).

The mean availability of medicines in public sector outlets for LPG medicines was lower in Sudan (40%) than in Oman (68.3%) and Tanzania (43.3%) but higher than in 7 of the countries compared as shown in figure (27).

**Figure 27:** International comparison of mean availability of LPGs in the public sector



The mean availability of OB medicines in the public sector was poorest in Sudan (4%) compared to Kuwait (12%), Oman (13%) and Nigeria (21%).

Table (36) shows that in the public sector in Sudan, affordability was improved compared with some of the countries when treating hypertension using Atenolol and diabetes using Glibenclamide .

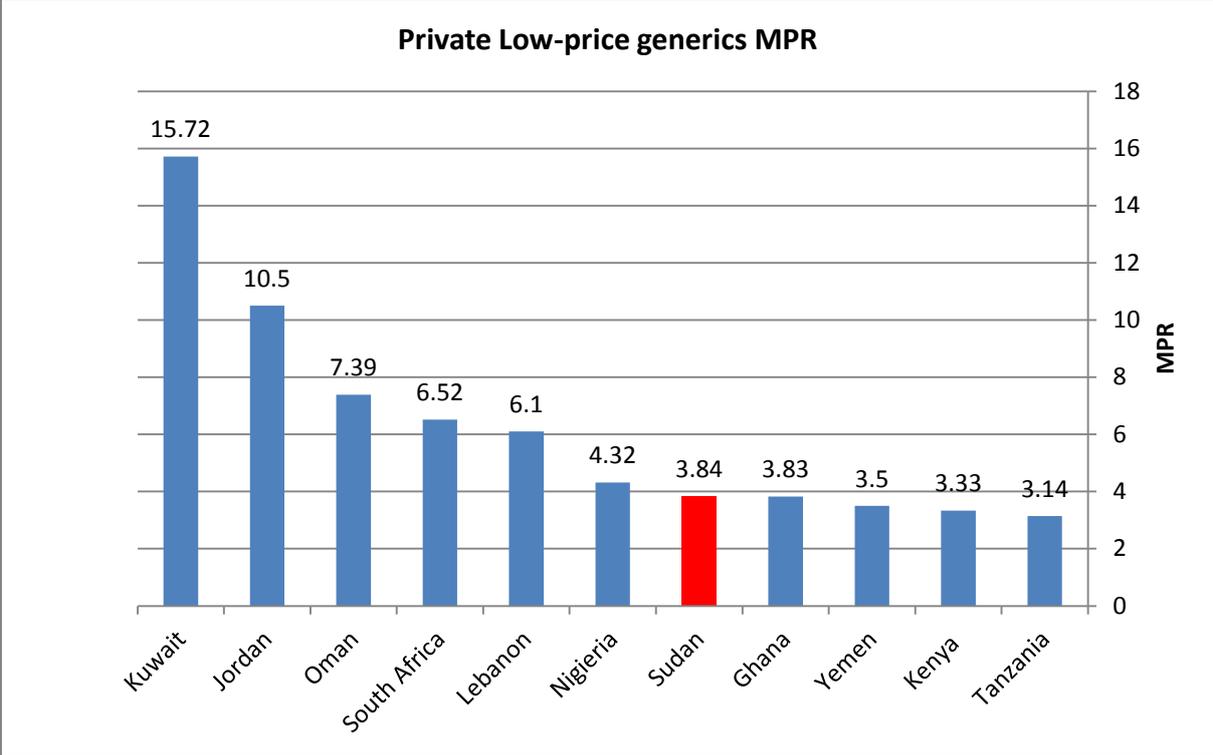
**Table 36:** Public sector affordability comparison between Sudan and some selected countries

	Affordability (No. of days wages required)				
	Country				
Condition (Medicine)	Sudan	Kenya	Ghana	Nigeria	Tanzania
Hypertension (Atenolol)	0.4	-	1.4	1.3	0.4
Diabetes (Glibenclamide)	0.5	0.4	1.3	4.1	1.1

**3.6.3. International comparisons of private sector patient prices**

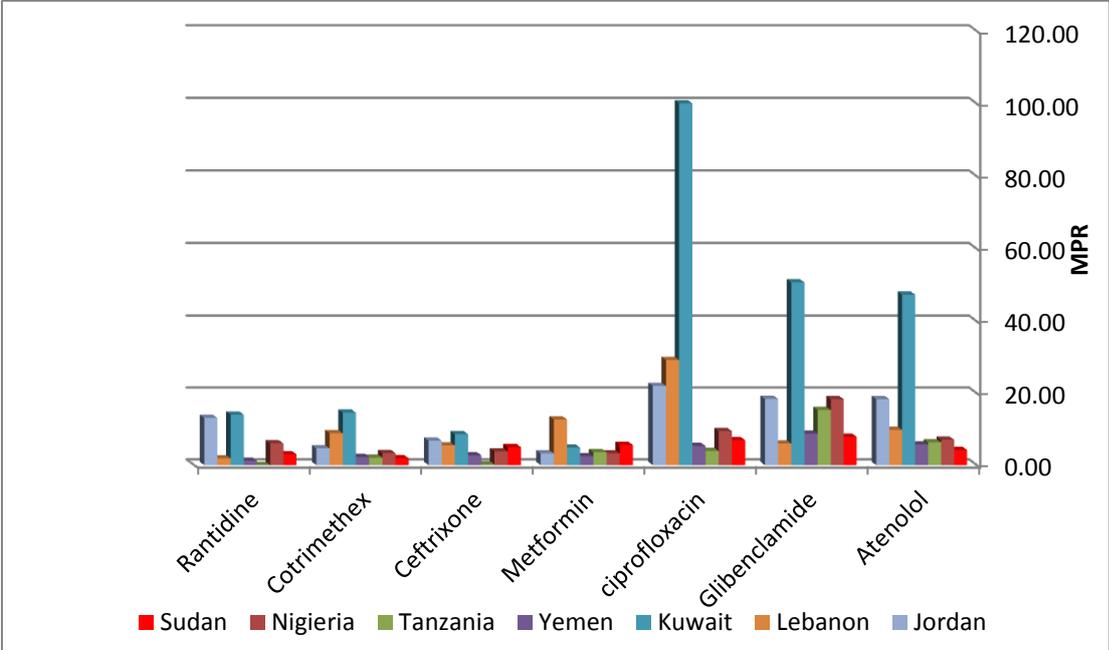
Overall patient prices for LPG were higher in Sudan (MPR 3.84) for some medicines but lower for others as shown in figure (28).

**Figure 28:** International comparison of private sector patient prices for lowest priced generics



A comparison of private sector patient prices for 5 individual LPG medicines could be made between Sudan and 6 of the 10 countries as shown in (Fig 29).

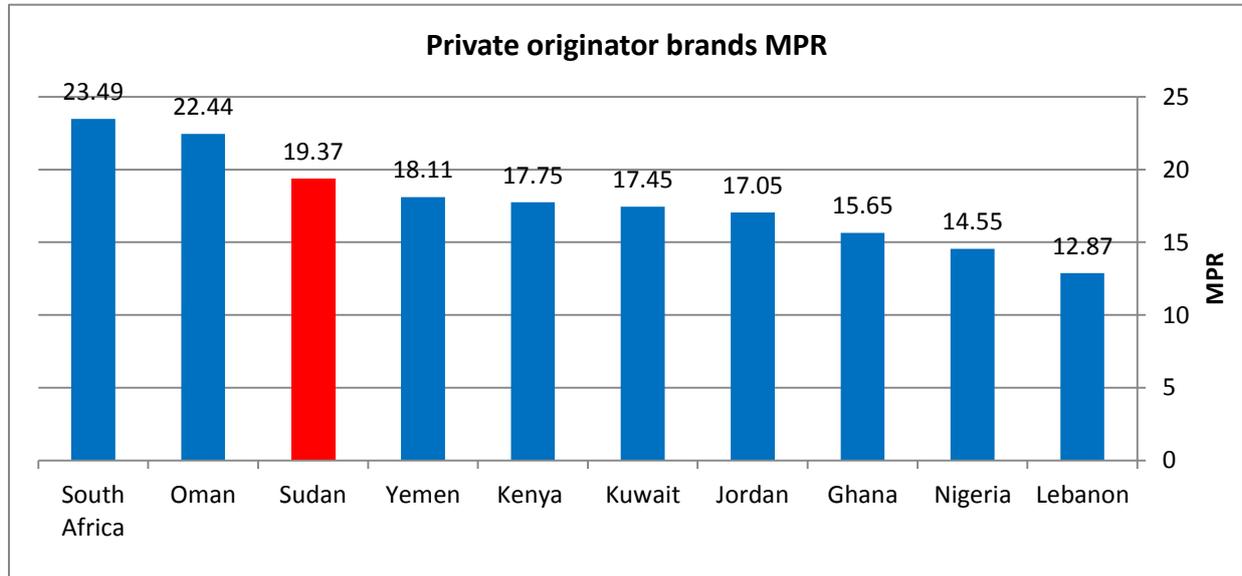
**Figure 29:** International comparison of private sector patient prices, individual medicines (lowest-priced generics)



In the private sector, for originator brands it was possible to compare Sudan patient prices with those from 9 of the countries. It showed that the overall Sudanese price (MPR for OB =

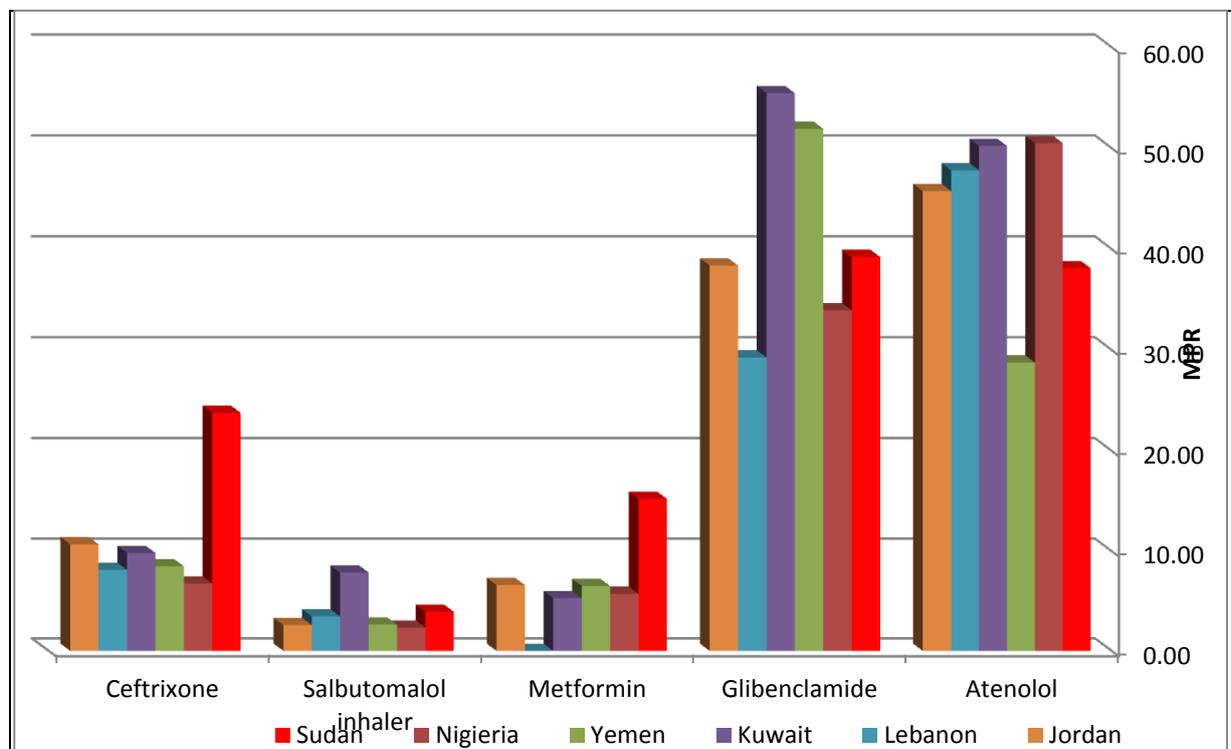
19.37) was higher than prices in 7 of the countries and lower than in Oman (MPR 22.44) and South Africa (MPR= 23.49) as shown in figure (30).

**Figure 30:** International comparison of private sector patient prices for originator brands



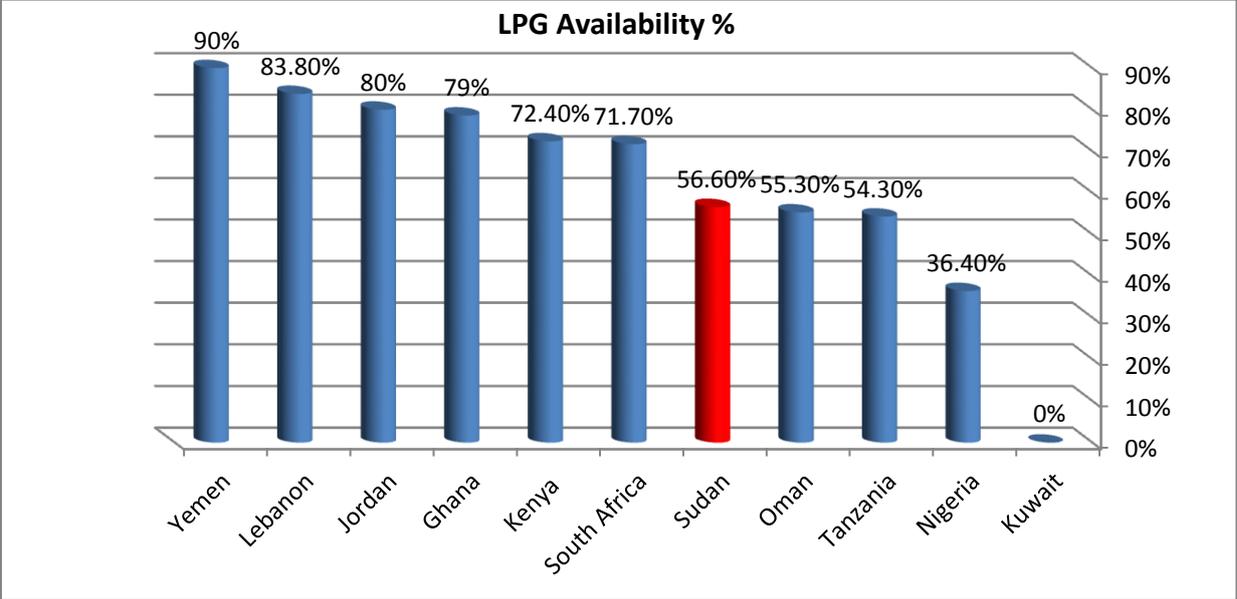
A comparison of 5 individual originator brands in the private sector was possible for 5 of the 10 countries as shown in (Fig 31).

**Figure 31:** International comparison of private sector patient prices for individual originator brands



The mean availability of LPGs in the private sector was higher in Sudan (56.6%) than 4 countries Oman (55.3%), Tanzania (54.3%), Nigeria (36.4%) and Kuwait (0%) but less than 6 of countries as shown in figure (32).

**Figure 32:** International comparison, mean availability of LPGs in the private sector



The mean availability of OB medicines in the private sector was lowest in Sudan (9.3%) compared to 9 of the 10 countries as shown in figure (33).

**Figure 33:** International mean availability comparison of OBs in the private sector

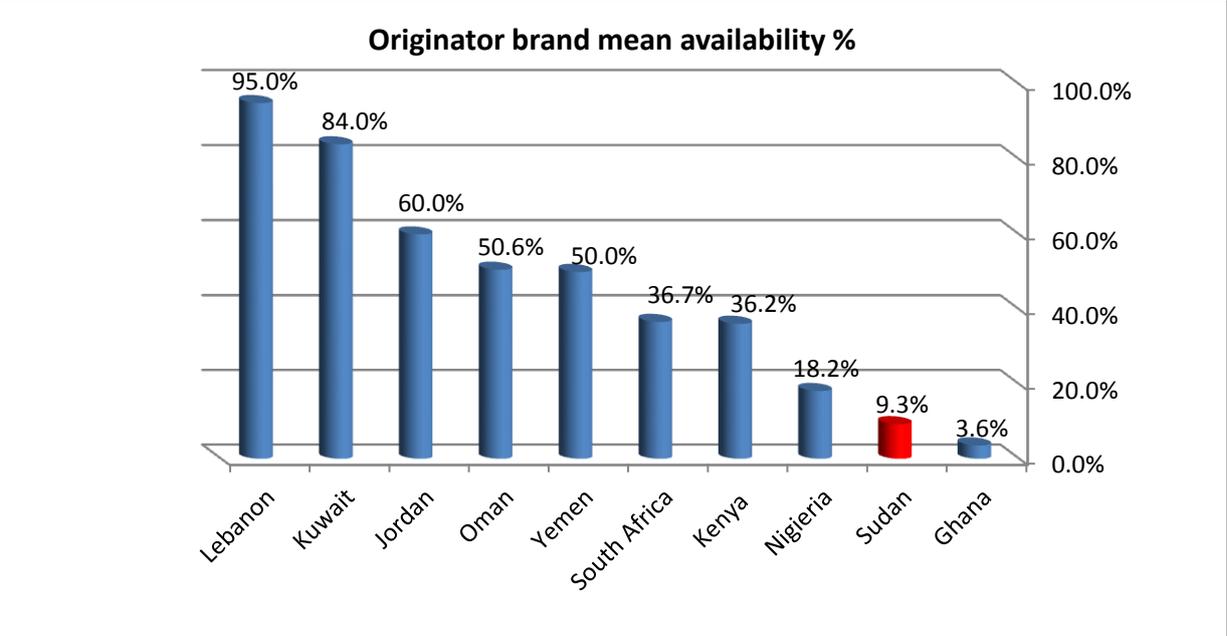


Table (37) shows that when treating hypertension using Atenolol, affordability in the private sector in Sudan is better for LPG medicines than in 5 countries, similar to Lebanon and Oman (0.4) and more unaffordable than in South Africa (0.3). Treatment of diabetes using

Glibenclamide was better in Sudan than in 5 countries and worse than 3 countries. Treatment of asthma using Salbutamol inhaler was similar in terms of affordability to Yemen (0.6), less affordable than in 4 countries, and better than in the remaining two countries.

**Table 37:** Private sector affordability comparison for LPGs between Sudan and some selected countries

	<b>Affordability (No. of days wages required)</b>								
	<b>Country</b>								
<b>Condition (Medicine)</b>	Sudan	Kenya	Yemen	Jordan	Lebanon	South Africa	Tanzania	Kuwait	Oman
<b>Hypertension (Atenolol)</b>	0.4	1.1	0.5	1.2	0.4	0.3	0.5	2.6	0.4
<b>Diabetes (Glibenclamide)</b>	0.5	1.4	0.7	1.1	0.3	0.2	1.1	3.3	0.9
<b>Asthma(Salbutamol inhaler)</b>	0.6	1.7	0.6	0.5	0.7	0.2	0.9	3	0.3

For Originator brand medicines in the private sector, affordability varied between Sudan and the other countries when treating hypertension using Atenolol , diabetes using Glibenclamide and asthma using Salbutamol inhaler as shown in table (38).

**Table 38:** Private sector affordability comparison for OBs between Sudan and some selected countries.

	<b>Affordability (No. of days wages required)</b>								
	<b>Country</b>								
<b>Condition (Medicine)</b>	Sudan	Kenya	Yemen	Jordan	Lebanon	South Africa	Nigeria	Kuwait	Oman
<b>Hypertension (Atenolol)</b>	3.4	9.7	2.7	3	1.8	1.7	10.2	2.7	1.1
<b>Diabetes (Glibenclamide)</b>	2.5	7.2	4.3	2.2	1.3	2.9	6.1	3.6	1.8
<b>Asthma (Salbutamol inhaler)</b>	2.1	-	1.5	1.2	0.9	0.6	3.3	3	1.4

### **International comparisons of price components in the private sector:**

Price components in Sudan’s private sector were compared with other countries although not all countries in the analysis had fixed mark-ups across all medicines (table 39).

**Table 39:** International comparison of price component summary for medicines in private sectors

<b>Country</b>	<b>MSP/CIP contribution</b>	<b>Port &amp; Clearance</b>	<b>Other duties</b>	<b>VAT or</b>	<b>Importer margin</b>	<b>Retail Margin</b>	<b>Distribution margin</b>	<b>Total mark-up</b>
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			or fees	Tax				over MSP
<b>Sudan</b>	66%	13%	-		15%	20%	-	48%
<b>Yemen</b>	63.5%	6%	7%	5%	10%	20%	-	48%
<b>Lebanon</b>	62.7%	11.5%	-	-	10%	30%	-	51.5%
<b>South Africa</b>	65.8%	-	19.6	14%	-	18.3%	-	51.9%
<b>Jordan</b>	61.8%	3.5%	0.2%	4%	19%	26%	-	52.7%
<b>Kuwait</b>	58.9%	-	-	-	35%	20%	-	55%
<b>Oman</b>	65%	5%	-		20. %	30%	-	55%
<b>Nigeria</b>	44%	30%			20%	30%	10%	90%
<b>Kenya</b>	44%	13%	2.75%		30%	33%	15%	93.75%
<b>Ghana</b>	42.3%	10%	2.5%	15%	35%	35%	-	107.5%

Sudan had the lowest cumulative mark-up over the MSP except for Yemen.

**Note:** Some of the data analysed in the above reports used the old version of price components recording format and other used the updated one. Some data was old and there may be changes since the country survey conducted, but for Sudan we used the recent updated calculation.

## 4. Discussion

The results of this medicine price survey provide insight into the availability, price and affordability of medicines in Sudan. The use of the WHO/HAI medicine prices survey has allowed for the measurement of medicine prices and availability in a reliable and standardized way that enables valid international comparisons to be made.

### 4.1. Pricing

These results show that patients are paying significantly more to purchase originator products than lowest price generics in all sectors surveyed. In Sudan public procurement of medicines is generally efficient in achieving reasonable prices but the patient price in the public sector was about two and half times greater than the public procurement price (Tender price), indicating substantial add-on costs in public distribution system for those medicines the government is purchasing. This may also be explained by the fact that the public sectors facilities belonging to CMS and RDF tend to base their prices more according to their competition (private retail pharmacies) than a simple mark-up on procurement price. They included mark-ups perhaps to cover their warehousing and distribution cost and to ensure that funds are not decapitalised and to ensure provision for depreciation due to inflation.

In the public sector, the MPR for lowest price generic medicines was 2.99 times their international reference price, while for originator brand medicines it was 8.03 times their international reference price (but only 3 originator brands were procured). In the private sector, the MPR of lowest price generic medicines was 3.84 times their international reference price, while for originator brand medicines was 19.37 times their international reference price. Though it is not possible to define the 'right' MPR in the private sector, we consider MPRs of less than 4 as reasonable and acceptable due to high inflation rate and deficiency of foreign currency.

Prices of originator brands are considerably higher than lowest-priced generic equivalents in all sectors. As is expected, generic medicines are more affordable than the originator brand equivalents. The generic versions were more readily available in all the sectors than the originator brands. This shows an acceptance of generic medicines in the country although there is no legislation requiring generic prescribing or substitution.

In a parallel study conducted by the General Directorate of Pharmacy (GDP) 2012-2013, found that LPGs medianMPR in public procurement was 1.87 for CMS and 2.7 for RDF. LPGs medianMPR for Public sector patient was 2.98 and private sector was 2.9. For OBs medianMPR in public procurement was 1.88 for RDF. OBs medianMPR in Public sector patient was 2.67 and for private sector was 4.24.<sup>22</sup>

## **4.2. Availability**

The survey showed low availability of the basket of medicines surveyed in both the public and private sectors; this is inconsistent with the results of a previous survey carried out in 2005 which shows availability of medicines in the public sector and private sectors were better than 2012. GDP study results show that LPGs availability was found to be 68.1% in the public patient sector and 83.9% in private sector and this difference between our results and GDP results may be accounted to the fact that GDP study did not include the (Darfur State - the real western region) in their study as it is a conflict area and considered (North Kordfan) as the western region and this is could not make their study actually representative for whole Sudan at the time of study. Also it may be because of the different baskets of medicines surveyed.

However; the intervention carried out by NMPB to reduce the prices in Sudan may have unintendedly had a negative effects on the availability as a result of discouraging the principals and importers in stocking medicines and make many companies less likely to invest in medicines and redirect their interest to other types of importation like paramedical, consumables and food supplements which is their pricing system uncontrolled like medicines. Other reasons may be the inflation happened during our survey period due to secession of South Sudan which contained over 80 percent of Sudan's oilfields, the economic forecast for Sudan in 2011 and beyond is uncertain owing mainly to loss of oil revenue by 75% from Sudan's budget which led to depletion of foreign exchange reserves and affecting the availability of foreign currency to import medicines from outside especially if we know that the imported drug constitute about 70% of whole registered medicines in Sudan. However, enforcing low prices could have a perverse effect on availability by providing a disincentive for stocking these products. In-depth studies are needed to determine factors affecting availability of medicines.

## **4.3. Affordability**

Affordability was also calculated in terms of the government worker who earns less than US\$ 3.20 per day. Few Sudanese are employees earning this minimum wage and indeed majority of Sudanese earn below US\$ 3.20 per day. While affordability was measured in terms of only a single medicine, it is important to note that studies show that the average number of medicines per prescription in Sudan is around 2 in public hospitals and primary care centres and more than that in private clinics.<sup>23-24</sup> Therefore, most conditions are treated with more medicines than calculated by this survey; as the real cost would be an aggregate of the cost of the individual medicines including the equipment used to deliver the medicines. The calculated medicine cost represents a fraction of what would actually be paid by a family at any given time other costs were not included such as doctor's fees and laboratory investigations, etc.

This study shows that the affordability of medicines is greatly dependent on the selection of medicine between the generic version and the originator brands with the latter being less affordable. Choice of sector was also important as there was decrease in cost of medicines in a descending order from the private sector, through the public health sector. Studies show that at least 65% of the population uses private pharmacies for their health needs<sup>25</sup>, may be because of the impression that the accessibility and availability of medicines in private pharmacies is better than the governmental public pharmacies. Even so, medicines are clearly unaffordable to most people especially the Sudanese poor populations who also spend more than 90% of their income on food. Irrational selection of medicines can have a great impact on affordability.

#### ***4.4. Price Components and Cumulative mark-up***

Mark-ups represent a large proportion of the price the patient pays in Sudan. Mark-ups vary from medicine to medicine and from sector to sector as shown in figures (15 -22) and tables (30-35). Analysis of costing documents shows that wholesale mark-ups are more variable than retail mark-ups among different sectors. The wholesale mark-ups in the public sector ranged from 125% in CMS to 240% in RDF, and in private sector mark-ups of wholesaler is fixed at 15% (although actual mark-ups were not measured), while the retail-up in the public sector ranged from 11% in CMS to 50% in RDF, and in private sector it is 20% (although this was not measured in the field). It seems that the public sector takes advantage of the low price of generics from tender prices to increase mark-ups. It supposed to be reflected positively on the availability of medicines in these sectors, by purchasing more drugs. Thus, interventions into procurement costing system may make a real difference in the cost and availability of medicines in public sector in Sudan.

#### ***4.5. International comparison***

Comparing procurement prices in Sudan with some other countries has confirmed the prices for lowest-priced generics in Sudan are lower than in some countries (but not others). Patient prices in the Sudanese private sector were also lower than in some of the countries for lowest priced generics. But Sudanese patient prices were high in the public sector which may confirm that the public sector in Sudan is not a pure public sector but rather acts as a private sector within public premises. The MPR of the originator brand prices in private sector are higher than in three Arab countries with much higher GDP per capita namely: Jordan, Lebanon and Kuwait.

#### ***4.6. Limitation of the study***

Firstly; Study results may be limited by the fact that data are inherently subject to outside influences such as market fluctuations and long time schedule of the study which was due mainly to some logistic problems encountered. Secondly; the availability is determined for the list of survey medicines, and therefore does not account for the availability of all registered medicines or alternate strengths or dosage forms, or of therapeutic alternatives. Thirdly; price components were reviewed from different sector documents and not taken from the field so we are unsure if mark-ups adhered to costing approved by the NMPB. Finally; the study done in 2005 which we compared with was restricted to Khartoum State, while our results are representing the whole country. The data may be more comprehensive if we make national to national comparison rather than state to national comparison.

## 5. Conclusions

In Sudan, the availability of the surveyed medicines was extremely low in all sectors as originator and 60% or less as generics (only 39.5% in the public sector) Generic medicines have been accepted in the country as they are more available than originator brands in all sectors.

To improve access to medicines, patients should pay procurement prices in the public sector plus a nominal distribution cost. High costs in procurement public distribution system added substantially to the price of generic medicines patients pay at public health facilities. The public sector should not work as private wholesalers and competitors to importing private companies. Public pharmacies in hospitals should not be act as private retail pharmacies financed by medicine sales revenue but should be financed by the government.

In both the private and public sectors, considerable price differences were seen between originator brands and generics. In general, originator brands were four times more expensive than the lowest priced generics.

Medicines are often unaffordable for ordinary citizens. The treatment of a chronic disease such as hypertension, where prices are high, availability low and affordability poor, warrants urgent attention. Service providers must be encouraged to dispense cheaper generics whenever possible to improve affordability of medicines As dispensers need incentives to dispense lower-priced generics, so we have to consider introducing regressive mark-ups rather than fixed percentage mark-ups,

The impact of policy changes made should be measured by establishing a monitoring system to regularly monitor not only the prices, but also the availability and affordability of medicines. The preliminary results of this study suggest that the price reduction policy need to be reconsidered to make medicines more available.

Although further investigation is required to obtain a more in-depth understanding of the causes and consequences of medicine pricing and availability, the results of this survey provide broad directions for future research and action.

This report is an outcome of a systematic study employing the World Health Organization/Health Action International (WHO/HAI) methodology and is an attempt to address the pricing problems. We strongly believe that the findings and suggestions given herein would give current and close picture about the medicines situation in Sudan, and would be helpful and useful for devising an effective pricing policy. The results highlight priority areas for action for the Ministry of Health and others in improving access to affordable medicines. Broad debate and dialogue are now needed to identify how best different players can contribute to the prospect of enhancing accessibility and affordability to essential medicines.

## 6. Recommendations

1. There is a need to review the government's medicines procurement policy
2. Encourage local pharmaceutical manufacturing to produce high demand quality-assured medicines at competitive prices
3. Encourage the registration of medicines to reduce prices of older brands and create competition
4. Use pharmacoeconomics tools and measurements including cost benefit analysis, cost-effectiveness analysis, cost-minimization analysis especially for high-cost single-source medicines
5. To improve affordability, reduce mark-ups in the public sector
6. Increase health insurance services coverage.
7. Review registered CIF prices in order to improve the affordability of medicines in the country
8. Encouraging prescribing by the generic name, dispensing of lower-priced generics and promote the use of generics by patients. This would need to be tied to research into medical practitioner and public attitudes towards generic medicines with appropriately designed educational interventions to increase acceptance. Key to this is ensuring all generics on the market are quality-assured.
9. Develop and promote the concept of a national formulary or standard treatment guidelines (STD) based on evidence-based selection and used in conjunction with national and/or hospital clinical guidelines implemented through therapeutic committees. This will help to identify effective, safe medicines, focus procurement and increase efficiency of the supply system, and provide a tool continued improvement and monitoring of prescribing and patient care
10. Repeat the medicines price survey at regular intervals to monitor the effects of policies on medicine prices and availability. The survey could be widened to all regions and also private hospital medicine prices to get a better picture of the private sector

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## 12. Annexes

### Annex I

List of medicines surveyed, strength, dosage form, and pack size

Medicine Name	Medicine Strength	Dosage Form	Target Pack Size	Medicine list	National Essential Medicine List
Albendazole	200 mg	cap/tab	2	Regional	no
Amitriptyline	25 mg	cap/tab	100	Global	yes
Amlodipine	5 mg	cap/tab	30	Supplementary	yes
Amoxicillin	500 mg	cap/tab	21	Global	yes
Amoxicillin suspension	50 mg/ml	milliliter	100	Regional	no
Amoxicillin+clavulanic acid suspension	25+6.25 mg/ml	millilitre	100	Supplementary	no
Amoxicillin+clavulanic acid tabs	500+125 mg	cap/tab	15	Supplementary	yes
Artensunate+Sulfadoxine+Pyrimethamine	50+500+25 mg	cap/tab	15	Supplementary	yes
Atenolol	50 mg	cap/tab	60	Global	yes
Atorvastatin	20 mg	cap/tab	30	Regional	yes
Azithromycin dry powder	40 mg/ml	millilitre	15	Supplementary	yes
Azithromycin caps	250 mg	cap/tab	6	Supplementary	yes
Beclometasone inhaler	50 mcg/dose	dose	200	Regional	yes
Captopril	25 mg	cap/tab	60	Global	yes
Carbamazepine	200 mg	cap/tab	100	Regional	yes
Cefixime suspension	20 mg/ml	millilitre	100	Supplementary	yes
Ceftriaxone injection	1 g/vial	vial	1	Global	yes
Chloramphenicol eye drops	0.5%	millilitre	5	Regional	yes
Chlorphenamine maleate	4 mg	cap/tab	10	Supplementary	yes
Ciprofloxacin	500 mg	cap/tab	10	Global	yes
Co-trimoxazole suspension	8+40 mg/ml	millilitre	100	Global	yes
Cough syrup millilitre	0.7+1.25 mg/ml	millilitre	100	Supplementary	no
Dexamethasone injection	4mg/ml	millilitre	1	Regional	yes

Diazepam	5 mg	cap/tab	100	Global	yes
Diclofenac	50 mg	cap/tab	100	Global	no
Erthyromycin	250 mg	cap/tab	20	Supplementary	yes
Ferrous sulpahte+Folic acid	200+0.4 mg	cap/tab	28	Supplementary	yes
Fluconazole	150 mg	cap/tab	1	Supplementary	yes
Fluoxetine	20 mg	cap/tab	30	Regional	yes
Furosemide	40 mg	cap/tab	30	Regional	yes
Gentmicin injection	40 mg/ml	millilitre	1	Supplementary	yes
Glibenclamide	5 mg	cap/tab	60	Global	yes
Gliclazide	80 mg	cap/tab	100	Regional	no
Hyoscine	10 mg	cap/tab	20	Supplementary	yes
Ibuprofen	400 mg	cap/tab	30	Regional	yes
Lisinopril	10 mg	cap/tab	30	Regional	yes
Loperamide	2 mg	cap/tab	10	Supplementary	yes
Metformin	500 mg	cap/tab	100	Regional	yes
Methyldopa	250 mg	cap/tab	30	Supplementary	yes
Metronidazole	400 mg	cap/tab	14	Regional	yes
Metronidazole suspension	40 mg/ml	millilitre	100	Supplementary	yes
Nifedipine Retard	20 mg	tab	30	Regional	yes
Nystatin oral drops	100000 IU	millilitre	30	Supplementary	no
Omeprazole	20 mg	cap/tab	30	Global	yes
Paracetamol	500 mg	cap/tab	20	Supplementary	yes
Paracetamol suspension	24 mg/ml	millilitre	60	Global	yes
Promethazine	25 mg	cap/tab	20	Supplementary	yes
Ranitidine	150 mg	cap/tab	60	Regional	yes
Salbutamol inhaler	100 mcg/dose	dose	200	Global	yes
Simvastatin	20 mg	cap/tab	30	Global	yes

## Annex II

Availability (%) of individual generic medicines in public outlets surveyed

<b>Product Name</b>	<b>Public availability</b>	<b>No</b>	<b>Product Name</b>	<b>Public availability</b>	<b>No</b>
Co-trimoxazole suspension	41.7%	26	Amitriptyline	0.0%	1
Cefixime suspension	42.9%	27	Fluoxetine	0.0%	2
Gentamicin injection	45.5%	28	Albendazole	4.2%	3
Metronidazole	45.5%	29	Loperamide	4.2%	4
Chloramphenicol eye drops	45.8%	30	Fluconazole	4.5%	5
Hyoscine	45.8%	31	Promethazine	8.3%	6
Amoxicillin+clavulanic acid tabs	47.6%	32	Gliclazide	9.1%	7
Carbamazepine	50.0%	33	Simvastatin	9.5%	8
Paracetamol suspension	50.0%	34	Salbutamol inhaler	12.5%	9
Lisinopril	52.4%	35	Diclofenac	18.2%	10
Amoxicillin	54.2%	36	Beclometasone inhaler	23.8%	11
Metronidazole suspension	54.2%	37	Diazepam	27.3%	12
Metformin	54.5%	38	Atorvastatin	28.6%	13
Amlodipine	57.1%	39	Azithromycin caps	31.8%	14
Ferrous sulphate+Folic acid	58.3%	40	Captopril	31.8%	15
Atenolol	59.1%	41	Ibuprofen	36.4%	16
Chlorphenamine maleate	59.1%	42	Methyldopa	36.4%	17
Glibenclamide	59.1%	43	Amoxicillin suspension	37.5%	18
Ceftriaxone injection	61.9%	44	Artensunate+Sulfadoxine+Pyrimethamine	37.5%	19
Dexamethasone injection	61.9%	45	Cough syrup	37.5%	20
Paracetamol	62.5%	46	Amoxicillin+clavulanic acid suspension	38.1%	21
Erythromycin	63.6%	47	Azithromycin	40.9%	22

Furosemide	63.6%	48	Nifedipine Retard	40.9%	23
Omeprazole	66.7%	49	Nystatin oral drops	40.9%	24
Ciprofloxacin	71.4%	50	Ranitidine	40.9%	25

### Annex III

Availability (%) of individual originator brand medicines in private outlets surveyed

Product Name	Private availability	No	Product Name	Private availability	No
Albendazole	7%	26	Amitriptyline	0%	1
Amoxicillin+clavulanic acid suspension	7%	27	Amoxicillin	0%	2
Diazepam	7%	28	Artensunate+Sulfadoxine+Pyrimethamine	0%	3
Diclofenac	7%	29	Atorvastatin	0%	4
Metronidazole suspension	7%	30	Beclometasone inhaler	0%	5
Omeprazole	7%	31	Captopril	0%	6
Ranitidine	7%	32	Chloramphenicol eye drops	0%	7
Azithromycin caps	11%	33	Chlorphenamine maleate	0%	8
Fluconazole	11%	34	Ciprofloxacin	0%	9
Paracetamol suspension	11%	35	Dexamethasone injection	0%	10
Amlodipine	14%	36	Erythromycin	0%	11
Amoxicillin+clavulanic acid tabs	14%	37	Ferrous sulphate+Folic acid	0%	12
Azithromycin	14%	38	Fluoxetine	0%	13
Ceftriaxone injection	14%	39	Gentamicin injection	0%	14
Lisinopril	14%	40	Ibuprofen	0%	15
Metronidazole	14%	41	Loperamide	0%	16
Glibenclamide	21%	42	Methyldopa	0%	17
Metformin	21%	43	Nifedipine Retard	0%	18
Atenolol	25%	44	Nystatin oral drops	0%	19
Cough syrup	29%	45	Promethazine	0%	20
Furosemide	29%	46	Simvastatin	0%	21
Salbutamol inhaler	32%	47	Amoxicillin suspension	4%	22
Carbamazepine	36%	48	Co-trimoxazole suspension	4%	23
Cefixime suspension	36%	49	Gliclazide	4%	24
Paracetamol	43%	50	Hyoscine	4%	25

### Annex IV

Availability (%) of individual generic medicines in private outlets surveyed

Product Name	Private availability	No	Product Name	Private availability	No
Azithromycin	60.71%	26	Albendazole	25.00%	1
Ceftriaxone injection	60.71%	27	Fluoxetine	25.00%	2
Diclofenac	60.71%	28	Captopril	32.14%	3
Amoxicillin suspension	64.29%	29	Amitriptyline	35.71%	4
Amoxicillin+clavulanic acid tabs	64.29%	30	Simvastatin	35.71%	5
Chloramphenicol eye drops	64.29%	31	Beclometasone inhaler	39.29%	6
Co-trimoxazole suspension	64.29%	32	Cough syrup	39.29%	7
Hyoscine	64.29%	33	Dexamethasone injection	39.29%	8
Lisinopril	64.29%	34	Methyldopa	39.29%	9
Azithromycin caps	67.86%	35	Salbutamol inhaler	39.29%	10
Chlorphenamine maleate	67.86%	36	Amoxicillin+clavulanic acid suspension	42.86%	11
Furosemide	67.86%	37	Atorvastatin	42.86%	12
Paracetamol	67.86%	38	Metronidazole	46.43%	13
Ranitidine	67.86%	39	Artensunate+Sulfadoxine+Pyrimethamine	50.00%	14
Amoxicillin	71.43%	40	Fluconazole	50.00%	15
Atenolol	71.43%	41	Gentamicin injection	50.00%	16
Ciprofloxacin	71.43%	42	Gliclazide	50.00%	17
Erythromycin	71.43%	43	Loperamide	50.00%	18
Omeprazole	71.43%	44	Nifedipine Retard	50.00%	19
Carbamazepine	75.00%	45	Paracetamol suspension	50.00%	20
Ferrous sulphate+Folic acid	75.00%	46	Promethazine	50.00%	21
Ibuprofen	75.00%	47	Diazepam	53.57%	22
Metformin	75.00%	48	Metronidazole suspension	53.57%	23

Amlodipine	78.57%	49	Nystatin oral drops	53.57%	24
Glibenclamide	85.71%	50	Cefixime suspension	57.14%	25