CHAPTER IV
RESULTS AND DISCUSSIONS

This chapter presents the results of the study, which are divided in to four parts. First part is the descriptive statistics of sample. Second part is prices, availability and affordability results. The third part is factors affecting medicine price results. The fourth part is the discussion of the whole result.

4.1. Descriptive statistics of sample

The sample consist of 50 item products (50 generics and it is correspondent brands) with their strength and dosage form in smallest unit (tablet, capsule, ml) in 99 (35 public, 36 private and 28 RDF) pharmacies at six states (Table IV-1 below shows the count of surveyed pharmacies in each sectors at different states)

The RDF medicine outlets were less than the other two sectors, because in River Nile state 3 RDF pharmacies were out of reach due to logistic obstacles, while in West Darfur; these were the RDF and public medicine outlets available within surveyed catchment area.

Table 4. 1 Pharmacy Surveyed at different Sectors

State	Public	Private	RDF	Total
Khartoum	6	6	6	18
West Darfur	5	6	4	15
River Nile	6	6	3	15
Sinnar	6	6	5	17
Gazeera	6	6	5	17
Port Sudan	6	6	5	17
Total	35	36	28	99

3593 prices observations were collected from above mentioned pharmacies at the six states during February 17 to March 10, 2013, data of medicines origin (imported or locally produced), the types of medicines (brand or generic) and the pharmacy site (rural or urban) were collected besides. Table 4.2 shows the distribution of medicines among different states and sectors according to medicines origin (locally produced or imported) and (generic or brand). The reason the brand column is zero at locally produced medicines as they were all imported, no brand is produced in the

country. In the same table the study reveal that the locally produced items represents 57.9% from the whole items surveyed, while the imported generics was 33.7% and only 8.4% for the brand

Table 4. 2 Distribution of Medicines type and Origin

		Medicine Origin			
		locally Produced		imported	
		Type of Medicine			
State	Sector	Generic	Brand	Generic	Brand
Khartoum	Public	92	0	77	11
	Private	156	0	108	77
	RDF	102	0	49	4
West Darfur	Public	113	0	36	5
	Private	147	0	75	6
	RDF	63	0	24	3
Gazeera	Public	106	0	65	8
	Private	125	0	112	42
	RDF	81	0	49	8
Sinnar	Public	127	0	38	5
	Private	158	0	95	30
	RDF	64	0	36	7
Port Sudan	Public	151	0	74	12
	Private	152	0	112	39
	RDF	100	0	65	3
River Nile	Public	142	0	66	7
	Private	153	0	106	28
	RDF	48	0	24	
Total		2080(57.9%)		1211(33.7%)	302 (8.4%)

Table 4. 3 Distribution of Generic and Brand medicine in the Public Sector

		Generic	**Brand**	**Total**
Khartoum	Count	169	11	180
	% within State	93.9%	6.1%	100.0%
West Darfur	Count	149	5	154
	% within State	96.8%	3.2%	100.0%
Gazeera	Count	171	8	179
	% within State	95.5%	4.5%	100.0%
Sinnar	Count	165	5	170
	% within State	97.1%	2.9%	100.0%
Red Sea	Count	225	12	237
	% within State	94.9%	5.1%	100.0%
River Nile	Count	208	7	215
	% within State	96.7%	3.3%	100.0%
Total	Count	1087	48	1135
	% within State	95.8%	4.2%	100.0%

Khartoum has the higher percentage of brand availability (6.1%), then Red Sea (5.1%), then Gazeera (4.5%), while the availability of the brand in River Nile was 3.3%, then West Darfur and Sinnar showed the lowest level of brands (3.2% and 2.9%) respectively. But generally the availability of brand in Sudan is very low (see table 4.2)

Table 4. 4 Count and Percentage of Generic and Brand in the Private Sector

		Generic	Brand	Total
Khartoum	Count	264	77	341
	% within State	77.4%	22.6%	100.0%
West Darfur	Count	222	6	228
	% within State	97.4%	2.6%	100.0%
Gazeera	Count	237	42	279
	% within State	84.9%	15.1%	100.0%
Sinnar	Count	253	30	283
	% within State	89.4%	10.6%	100.0%
Red Sea	Count	264	39	303
	% within State	87.1%	12.9%	100.0%
River Nile	Count	259	28	287
	% within State	90.2%	9.8%	100.0%
Total	Count	1499	222	1721
	% within State	87.1%	12.9%	100.0%

In the private sector Khartoum has higher frequencies of generics 264 and higher frequencies of IB 77 compare to other states, however Res Sea has the same generic frequencies 264 but less IB 39 than Khartoum, West Darfur has the lesser frequencies of generics and IB (6) (See table 4.4)

Table 4. 5 Count and Percentage of Generic and Brand in the RDF Sector

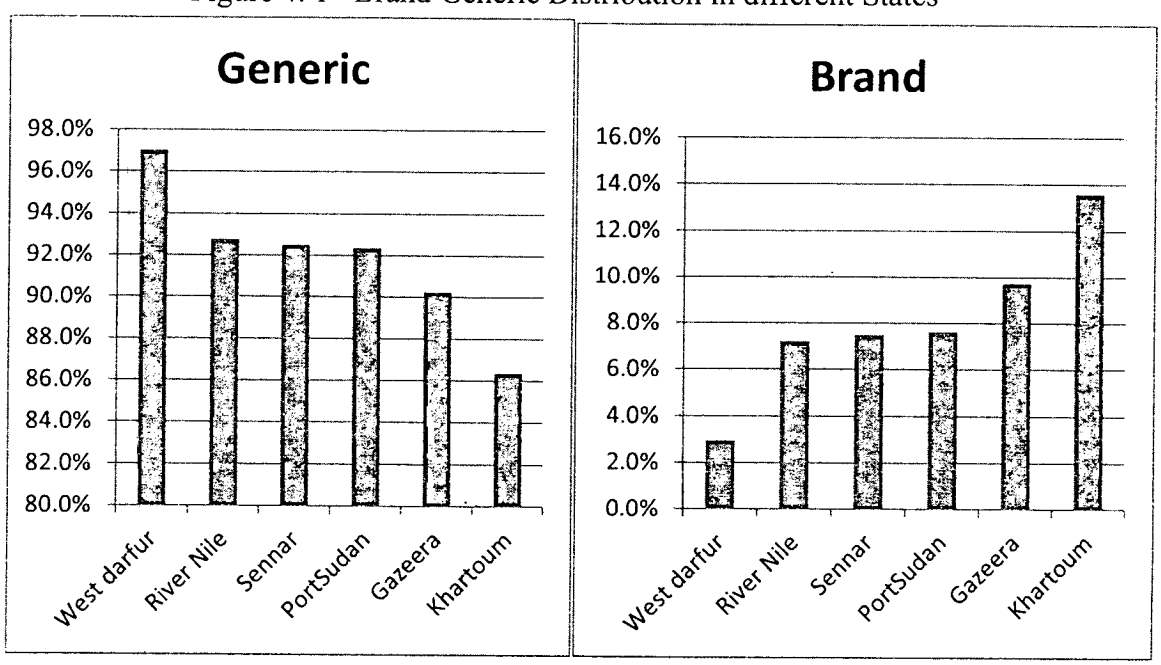
		Generic	Brand	Total
Khartoum	Count	151	4	155
	% within State	97.4%	2.6%	100.0%
West Darfur	Count	87	3	90
	% within State	96.7%	3.3%	100.0%
Gazeera	Count	130	8	138
	% within State	94.2%	5.8%	100.0%
Sinnar	Count	100	7	107
	% within State	93.5%	6.5%	100.0%
Red Sea	Count	165	3	168
	% within State	98.2%	1.8%	100.0%
River Nile	Count	72	7	79
	% within State	91.1%	8.9%	100.0%

In RDF sector Red Sea State has the higher frequencies of generics (165) then Khartoum state (151), while the higher level of frequencies in IB was in Sinnar and River Nile states (7), while the later has the lowest generic frequencies 72. But West Darfur and Red Sea has the lowest frequencies of IB (3) (see table IV- 5)

Table 4. 6 Count and Percentage of Generic and Brand in All three Sectors

		Generic	Brand	Total
Khartoum	Count	584	92	676
	% within State	86.4%	13.6%	100.0%
West Darfur	Count	458	14	472
	% within State	97.0%	3.0%	100.0%
Gazeera	Count	538	58	596
	% within State	90.3%	9.7%	100.0%
Sinnar	Count	518	42	560
	% within State	92.5%	7.5%	100.0%
Red Sea	Count	654	54	708
	% within State	92.4%	7.6%	100.0%
River Nile	Count	539	42	581
	% within State	92.8%	7.2%	100.0%
Total	Count	3291	302	3593
	% within State	91.6%	8.4%	100.0%

Figure 4. 1 Brand Generic Distribution in different States



In figure IV- 1 above, West Darfur state showed higher percentage of generic (97%) when compared to brands, while Khartoum states shows 86% of the items

surveyed were generic and 14% for IBs, States like Red Sea, Sinnar and River Nile have the same level of generics (> 92%)

Tables 4.3, 4.4, 4.5, 4.6 summarizes the percentage of brand and generic among different states through the three sectors to reflect what is shown in figure 4.1 above.

Table 4. 7 Summary of Generic/Brand found according to Sectors

Type of Medicine	State	Sector			Total
		public	private	RDF	
Generic	Khartoum	169	264	151	584
	West Darfur	149	222	87	458
	Gazeera	171	237	130	538
	Sinnar	165	253	100	518
	Red Sea	225	264	165	654
	River Nile	208	259	72	539
	Total	1087	1499	705	3291
Brand	Khartoum	11	77	4	92
	West Darfur	5	6	3	14
	Gazeera	8	42	8	58
	Sinnar	5	30	7	42
	Red Sea	12	39	3	54
	River Nile	7	28	7	42
	Total	48	222	32	302
Total	Khartoum	180	341	155	676
	West Darfur	154	228	90	472
	Gazeera	179	279	138	596
	Sinnar	170	283	107	560
	Red Sea	237	303	168	708
	River Nile	215	287	79	581
	Total	1135	1721	737	3593

In table 4.7 and figure 4.2 and figure 4.3 explain items frequencies, the frequencies of the generics in the private sector was 1499, 1087 the public sector and 705 for the RDF sector. The frequencies of the IBs as revealed by this study 222, 48 and 32 respectively.

Figure 4. 2 Distribution of Brands in States According to Sectors

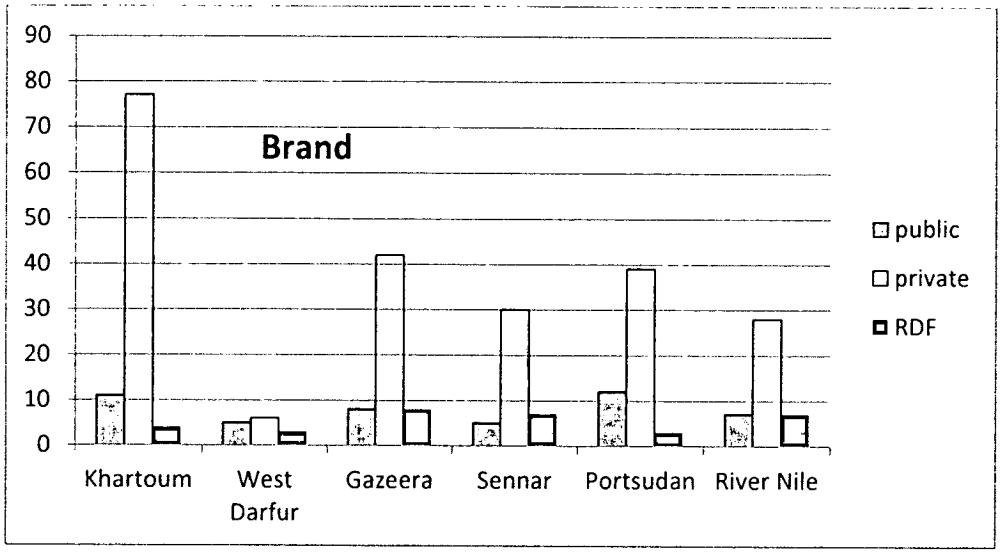
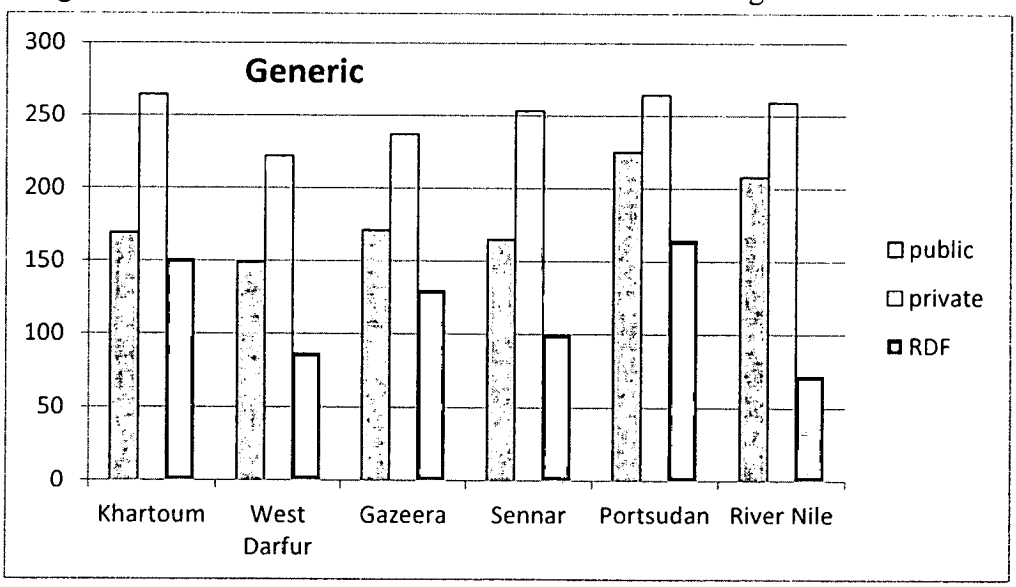


Figure 4. 3 Distribution of Generics in States According to Sectors



Private sector as shown in figure 4.2 and 4.3 has the high frequencies of generic and brand than the public sector.

cost at the level not to exceed their management capacity which depend mainly on the central tender supply system that supply the state NHIF pharmacies each three month (4th times a year), this in January, April, July and October, and the survey conducted during last ten days of February and 1st 10 days of March where the supply usually be at the lowest level.

There higher number of the generic found in the public sector was in Port Sudan (225generic). While the lowest was West Darfur (149generic) which is the most far state from the capital, followed by Khartoum State (169 generic) and this mainly because the public medicine outlets at Khartoum state taken in this study managed by the hospitals, while other public facilities at other states managed by NHIF. But the private sector has higher frequencies of generics for the same reason mentioned before, Khartoum and Port Sudan recorded the highest number of generics in the sector (265) , economically the two states considered as the best in the country where the economic and commercial activities is very high. The RDF sector which recorded the lowest frequencies of generic, we observed that Port Sudan was the best (165) and River Nile (72) was the least.

4.2. Medicine prices

4.2.1. The Median Price Ratios (MPRs)

Table 4. 8 Median MPR for Medicines with Minimum No. of Prices in all sectors

	GPP	Public	Private	RDF
Brand		2.67	4.24	1.88
Lowest Price	1.84	2.98	2.90	2.70

The results in table IV-1 show that the government procurement prices (GPP) for generics is 1.84 times the international reference prices, while the brand named medicines were sold in public sector 2.67 times it is international reference prices, 4.24 in the private sector and 1.88 in the RDF sector, at the same time the lowest price generics was sold in 2.98 times it is international reference price, 2.9 in the private sector and 2.7 in the RDF sector.

4.2.2. Government procurement prices

Table 4. 9 Median of MPR of GPP of all medicines

Product type	Median MPR	25th percentile	75th percentile
Lowest price generic (n = 49 medicines)	1.84	1.16	3.24

Of the 50 medicines included in this national survey, 49 generics were found the public sector as procurement prices, the public sector surveyed is exclusively procuring generic medicines, regarding the MPR, the public sector procuring generic at 1.84 times their international reference prices, so the government procuring at fair efficiency, the interquartile range revealed moderate variation across individual medicines.

Generic medicines being purchased at prices less than IRP include Hyoscine - N-Butylbromide (0.88), Norethiesterone 5mg tablet (0.82), Oral rehydration Salt (0.81), Lisinopril 5mg tablet (0.79), Salbutamol syrup (0.65), Atorvastatin 20mg (0.63), Gliclazide 80mg tablet (0.56), Amlodipine 5mg tablet (0.56), Insulin soluble (0.43) and Artemether 80mg injection (0.36). On the other hand, medicines for which the public sector is paying several times the international (IRP) include Diclofenac 50mg (23.16), Ferrous Sulphate + folic acid (12.2) and Fluoxetine 20mg tab (8.06)

[See Appendix L contains procurement prices for individual medicines]

4.2.3. Public sector retail prices

Table 4. 10 The Median of MPR in public sector retail prices

Product type	Median MPR	25th percentile	75th percentile
Originator brand (n = 3 medicines)	2.67	1.68	3.24
Lowest price generic (n = 49 medicines)	2.98	1.66	4.69

The results shown it table IV-2 above explain that the originator brand products are generally sold at 2.67 times their international reference price. Half of the originator brand medicines were priced at 1.68 (25th percentile) to 3.24 (75th percentile) times their international reference price; there is therefore moderate variation in MPRs across individual originator brand medicines in the public sector.

Lowest price generic medicines are almost sold at 2.98 times their international reference price. Half of the lowest priced generic medicines were priced at 1.66 (25^{th} percentile) to 4.69 (75^{th} percentile) times their IRP; therefore, there is moderate variation in MPRs across individual lowest price generics in the public sector.

Table 4. 11 The Median of MPR in RDF sector retail prices

Product type	Median MPR	25th percentile	75th percentile
Originator brand (n = 6 medicines)	1.88	1.09	3.89
Lowest price generic (n = 46 medicines)	2.70	1.88	4.24

The results shown in table IV-3 above in the RDF sector, the originator brand drugs are almost retailed at 1.88 times their international reference price. 50% of the brand drugs were priced at 1.09 (25th percentile) to 3.89 (75th percentile) times their international reference price; hence moderate variation in MPRs across individual IB medicines in the public sector.

Lowest price generic medicines are sold at 2.70 times their international reference price and 50% of generic medicines were retailed at 1.88 (25th percentile) to 4.24 (75th percentile) times their international reference price; hence there is moderate variation in MPRs across individual generic drugs in the RDF sector.

Brand products priced several folds more than IRPs include Carbimazole 5mg tablet (MPR = 3.81) and Salbutamol inhaler (MPR = 2.67). The 25th and 75th percentiles for individual medicines show that, for originator brands, there are no significance variations between public sector pharmacies. Generic products were retailed at prices several times more the IRPs include Diclofenac 50mg tablet (MPR = 29.3), Ferrous sulphate + folic acid (MPR = 21.22), Ceftriaxone 1g injection (MPR = 12.96). The 25th and 75th percentiles for individual medicines show that, for generic medicines, prices vary significantly between public sector pharmacies.

[See Appendix N contains the median price ratios for individual medicines found in the public sector]

4.2.4. Comparison of retail and procurement prices in the public sector

Table 4. 12 MPR for medicines found in procurement and retail public sector

Product type	Median MPR Public Procurement	Median MPR Public Patient Prices	% difference patient prices to procurement
Lowest price generic (n = 49 medicines)	1.75	2.84	62.4%

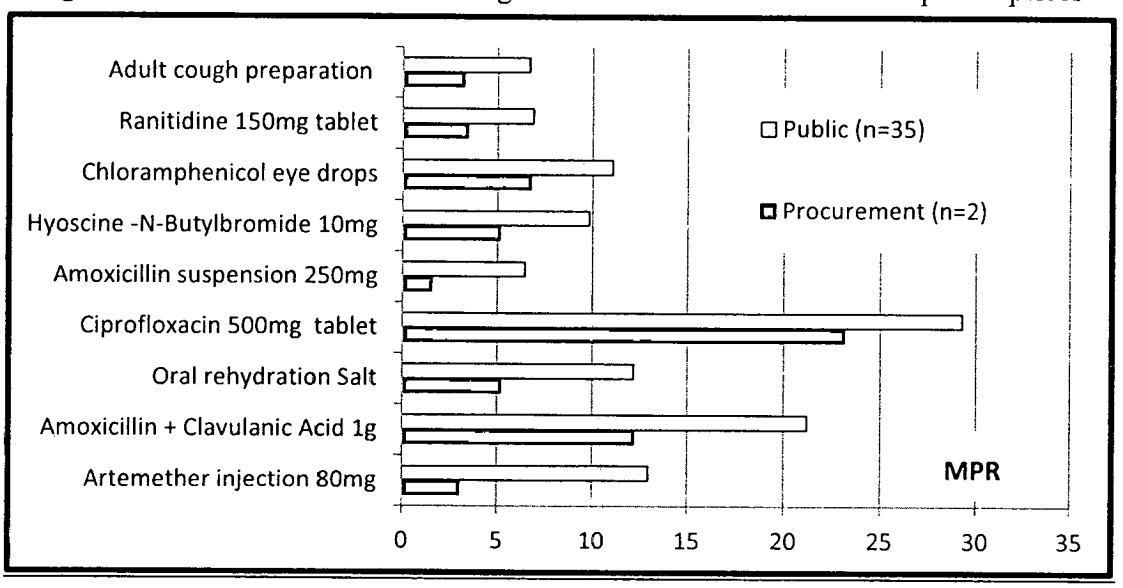
Table IV-4, to allow comparison between procurement prices and retail prices in public sector only medicines found in both public procurement and public sector pharmacies were included in the analysis . Results show that final retail prices in the public sector are 62.4% more than procurement prices for lowest price generics

Table 4. 13 MPR for medicines found in procurement and retail public sector

Product type	Median MPR Public Procurement	Median MPR Public Patient Prices	% difference patient prices to procurement
Lowest price generic (n = 49 medicines)	1.84	2.61	41.9%

Results show that final patient prices in the RDF sector are 41.9% higher than procurement prices for generic. Form results shown in two tables above, The RDF sector has lower mark-up when compared to other public sector, the difference in mark-up reached up to 20%.

Figure 4. 4 Differences in selected generics between GPP and retail public prices



The figure above show the differences between government procurement prices and the retail prices in public sectors outlets, only Artemether injection 80mg, Amoxicillin suspension 250mg/5ml and Oral rehydration salts have difference more than 50%.

4.2.5. Private sector retail prices

The originator brand drugs are almost retailed at price 4.24 times their international reference price. 50% of IB products were priced at 3.32 (25th percentile) to 8.18 (75th percentile) times their correspondent IRPs; hence there are substantial differences in MPRs across individual IB products in the private sector.

Lowest price generic medicines are generally sold at 2.9 times their international reference price. Half of the lowest priced generic medicines were priced at 2.01 (25th percentile) to 5.18 (75th percentile) times their international reference price; there is therefore substantial variation in MPRs across individual generic medicines in the public sector. [see table IV-5 below and Appendix O contains the median price ratios for individual medicines found in the private sector]

Table 4. 14 The median of MPRs in private sector for all medicines

Product type	Median MPR	25th percentile	75th percentile
Originator brand (n = 14 medicines)	4.24	3.32	8.18
Lowest price generic (n = 50 medicines)	2.90	2.01	5.18

Brand named products were retailed at prices several times more than IRPs include, Atenolol 50mg tablet (MPR = 31.52), Paracetamol 500mg tablet (MPR = 13.08), Carbimazole 5mg tablet (MPR = 12.02). The 25th and 75th percentiles for individual products proof that, for brands, prices vary obviously between private sector pharmacies. LPG medicines retailed at prices number of times more than international reference prices include Diclofenac 50mg tablet (MPR = 27.13), Ferrous sulphate + folic acid capsule (MPR = 19.45), Artesunate 100mg tablet (MPR = 9.83). The 25th and 75th percentiles for individual medicines tell that, there is no significant variation between private sector pharmacies.

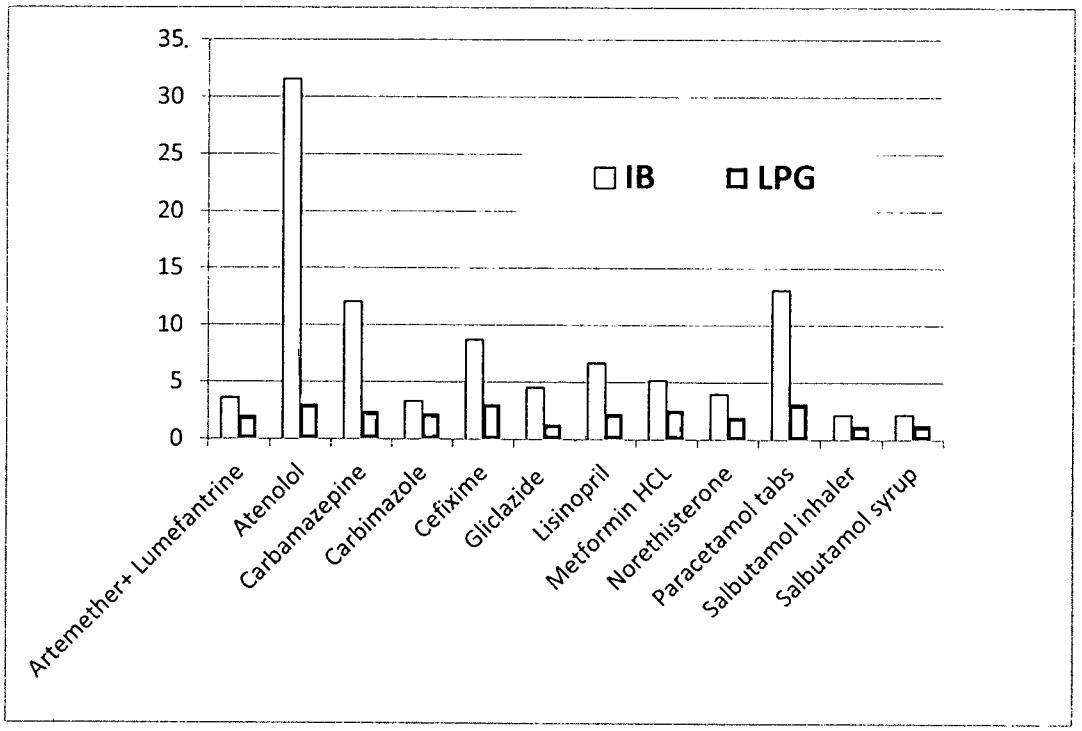
Table 4. 15 Comparison of MPRs of IB and LPG in private sector

Type (n = 14 medicines)	Median MPR	25 %ile	75 %ile
Originator brand	4.24	3.32	1.44
Lowest price generic	2.10	8.18	2.53

In table IV-6 above, only those medicines, for which both OB and LPG equivalent product were found, were included in the analysis to allow for the comparison of MPs between the two medicines types. Findings show that in the

private sector, OB cost 100% more, than their LPG equivalent. There for, people are paying more when prescribed to OB than LPG.

Figure 4. 5 MPR for selected OB and LPG in private sector



The results the figure above show that the MPRs of selected OB and their equivalent LPG, the MPR of OB is generally high than those for lowest price generics, the highest difference were found in Atenolol 50mg tablet and Paracetamol 500mg tablet, the MPR within individual OB vary substantially.

4.2.6. Comparison of retail prices in public, RDF and private sectors

Table 4. 16 Comparison of MPRs between public and private sectors

Product type	Median MPR Public sector patient prices	Median MPR Private sector patient prices	% difference private to public
Originator brand (n = 3 medicines)	2.67	2.14	-20.0%
Lowest price generic (n = 49 medicines)	2.98	2.82	-5.3%

In table IV-7 above, the analysis was restricted to medicines available in both sectors, to compare prices between them. Results show that final retail prices in the

private sector are 20.0% and 5.3% lower than in the public sector for OBs and generic equivalents, respectively.

Table 4. 17 Median MPRs for medicines found in both private and RDF sectors

Product type	Median MPR RDF sector patient prices	Median MPR Private sector patient prices	% difference private to RDF
Originator brand (n = 6 medicines)	1.88	2.88	34.5%
Lowest price generic (n = 46 medicines)	2.70	3.00	9.9%

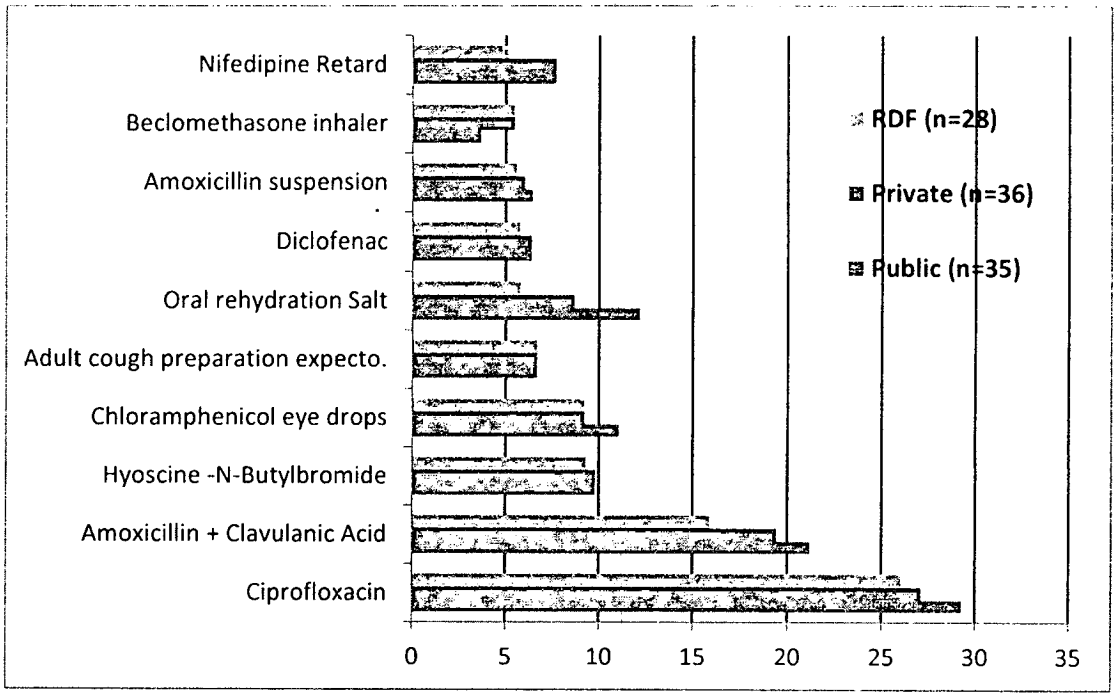
In the above table, comparison analysis for only the medicines those available private and RDF sectors was. Findings revealed that final patient prices in the private sector are 34.5% and 9.9% more than in the RDF sector for OBs and LPGs equivalents, respectively. However the availability of drugs in the RDF sector is low, patients are paying substantially higher retail prices to purchase medicines from the private sector and other public sector pharmacies (NHIF).

In the table below, only OBs and LPGs found in both sectors were included in the analysis to allow for the comparison of prices between the two types of public sectors (NHIF and RDF) to know the variation within the same sector but different context and objectives. Results show that final patient prices in the public sector are 47.2% and 11.3% higher than in the RDF sector for OBs and LPGs equivalents, respectively.

Table 4. 18 Median MPRs for medicines found in both public and RDF sectors

Product type	Median MPR RDF sector patient prices	Median MPR Public sector patient prices	% difference public to RDF
Originator brand (n = 6 medicines)	0.89	1.68	47.2%
Lowest price generic (n = 46 medicines)	2.70	3.05	11.3%

Figure 4. 6 MPRs comparisons for a selected medicines across all sectors



4.2.7. Regional analysis

Comparison of prices and availability across the six regions surveyed

As shown in table IV-8 below, the median MPR for LPGs in the private sector differed clearly across all surveyed six states (ANOVA test prove that there is significant different in prices between the six states surveyed, see table 4.7). Drugs retail prices were lowest in Khartoum State and highest in Wes Darfur State. Median MPRs for OBs vary from 2.82 in River Nile to 7.8 in Gazeera State. Median MPRs for LPGs ranged between 2.61 in Khartoum State to 3.71 in West Darfur.

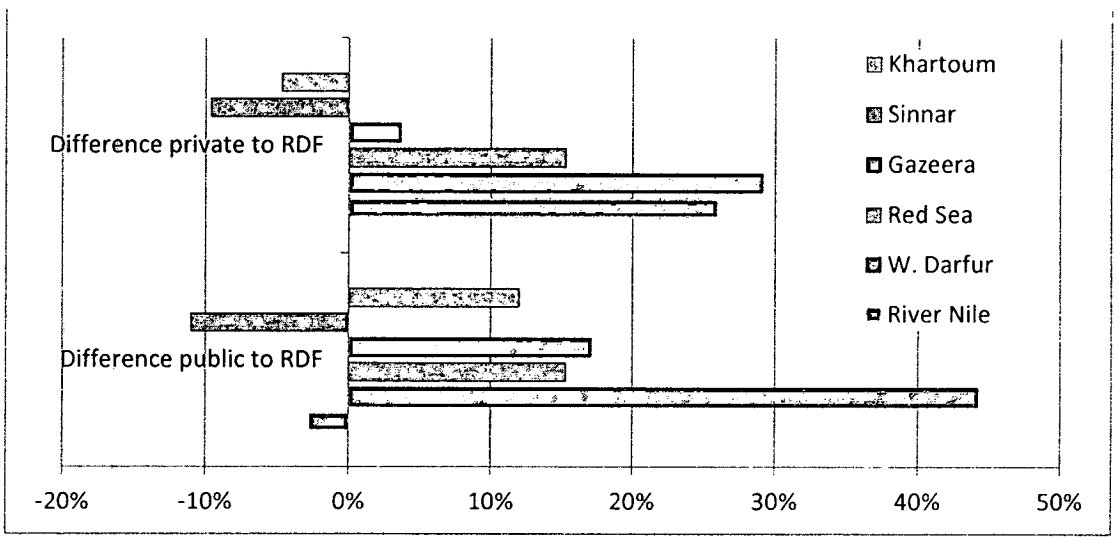
Table 4. 19 ANOVA test, prices variations among states

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1700.541	387	4.394	1.548	.000
Within Groups	9097.009	3205	2.838		
Total	10797.550	3592			

Table 4. 20 Median MPRs per survey area, private sector

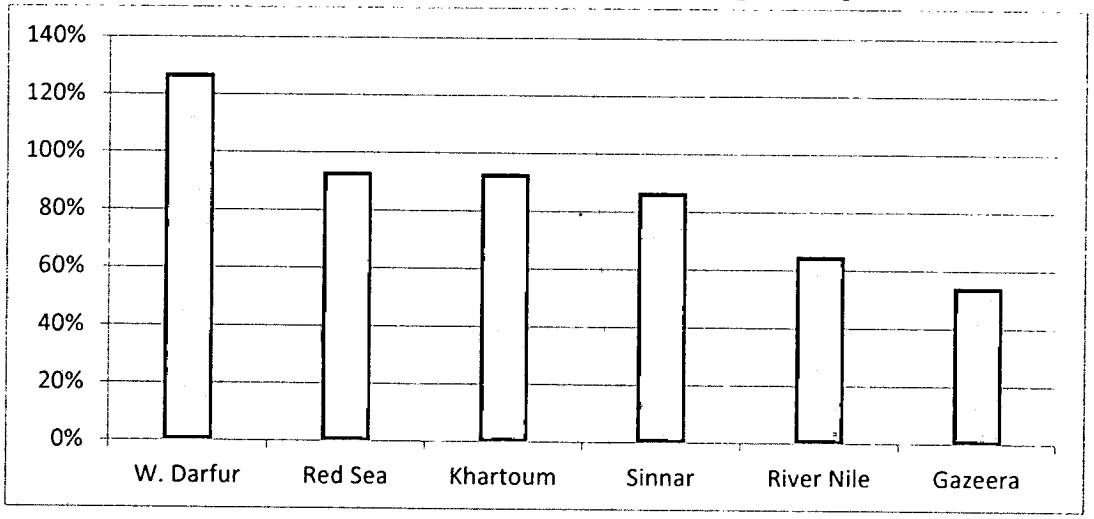
	River Nile	W. Darfur	Red Sea	Gazeera	Sinnar	Khartoum
Median MPR	(2 meds)	(0 meds)	(6 meds)	(4 meds)	(2 meds)	(9 meds)
Originator brand	2.82	--	4.9	7.8	7.02	3.47
Median MPR	(44 meds)	(36 meds)	(45 meds)	(41 meds)	(46 meds)	(45 meds)
Lowest price generic	3.06	3.71	3.01	2.84	2.86	2.61
Difference public to RDF	- 2.8 %	44.2%	15.3%	17.1%	- 11%	12%
Difference private to RDF	26.0%	29.1 %	15.3	03.6%	- 9.6%	- 4.7%
Difference public to procurement	65.0%	127.2%	93.3%	54.3%	86.8%	93.1%

Figure 4. 7 Comparison of RDF to private and public sector



The above figure show the results that common case in all states that RDF sector has lowest MP when compared to private and public sector, except in River Nile where public sector has lower prices than RDF, while in Sinnar RDF has higher prices than private and public sector. However the difference in the public sector is slightly higher. In Khartoum state, the private sector prices were set at level lower than RDF prices.

Figure 4. 8 Difference between GPP and retail price in public sector



In the figure IV-1 above the highest difference between the government procurement prices and public sector price found in West Darfur (more than 120%), and the lowest difference was in Gazeera State (less than 60%)

4.3. The availability of surveyed medicines

Table 4. 21 Mean availability of medicines, public, RDF and private sectors

	Public Sector (n=35 outlets)		Private Sector (n=36 outlets)	RDF Sector (n=28 outlets)
	All medicines (n=49)	EML medicines only (n=45)	all medicines (n=50)	
Brand	3.7% (Std 9.9%)	4%	14.4%	4.5%
Lowest Price	68.1% (Std 25.7%)	68.2%	83.9%	55.4%

Average availability of all survey medicines in the public sector was fair at 68.1% and 55% for RDF When analysis is limited to survey medicines listed on the national EML, public sector availability stays constant at 68.2%.for public, while it slightly increase for RDF to 55.4%.In the public sector, generics were the highest available Also the in the RDF.

Average availability in the private sector was good at 83.9%, generics were the predominant product type available. In the private sector, medicine availability was higher than that of the two public sectors.

Appendix L contains the availability of individual medicines in both public and private sectors. In the public sector, medicines with particularly low availability include Salbutamol inhaler (14.3%), Salbutamol syrup (14.3%), Simvastatin (0.0%).

In the RDF sector, medicines with particularly low availability include Salbutamol inhaler (0.0%), Salbutamol syrup (0.0%), Simvastatin (0.0%). In the private sector, medicines with particularly low availability include Salbutamol inhaler (16.7%), Salbutamol syrup (16.7%), Simvastatin (0.0%)

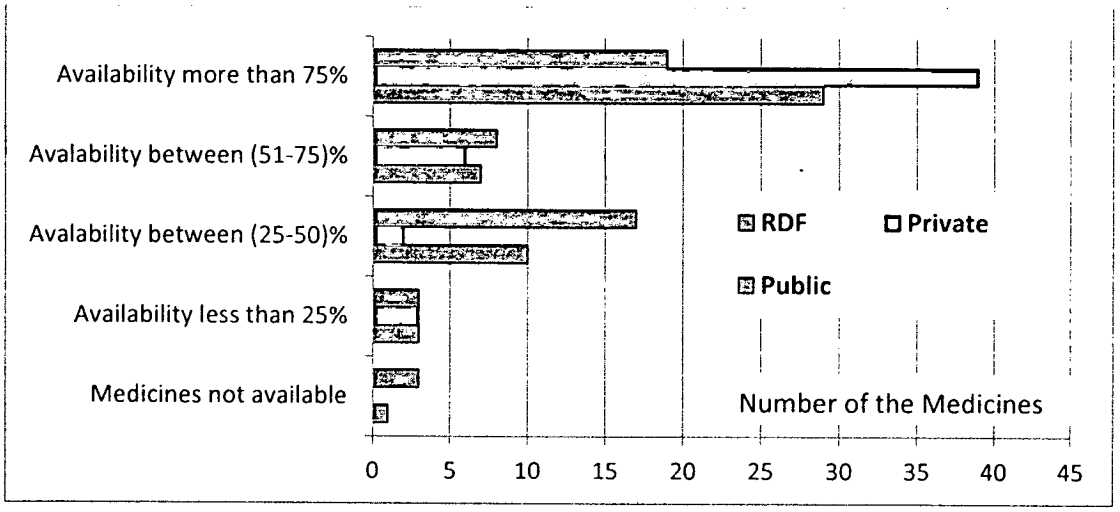
Table 4. 22 Summary of individual Drug availability in public sector

Medicines not found in any outlets		1. Simvastatin 20mg tablet
Medicines found in less than 25% of outlets		1. Salbutamol syrup 2. Glibenclamide 5mg tablet 3. Salbutamol inhaler
Medicines found in 25 to 50% of outlets		1. Chloramphenicol eye drops 2. Nifedipine Retard 20mgtablet 3. Ciprofloxacin 500mg tablet 4. Metronidazole 500mg tablet 5. Ranitidine 150mg tablet 6. Hyoscine -N-Butylbromide 7. Omeprazole 20mg tablet 8. Ibuprofen 400mg tablet 9. Metronidazole 250mg tablet 10. Oral rehydration Salt
Medicines found in 50 to 75% of outlets		1. Dexamethasone injection 2. Lisinopril 10mg tablet 3. Atorvastatin 20mg tablet 4. Cefixime 400mg capsule 5. Norethiesterone 5mg tablet 6. Amoxicillin +ClavulanicAcid1g 7. Paracetamol tabs 500mg 8. Furosemide 40mg tablet 9. Metformin HCL 500mg tablet
Medicines found in over 75% of outlets	1. Amitriptyline 25mg tablet 2. Amoxicillin suspension 3. Artemether injection 4. Artesunate 50mg tablet 5. Ceftriaxone injection 1g 6. Adult cough preparation 7. Beclomethasone inhaler 8. Albendazole 200mg tablet 9. Captopril 25mg tablet 10. Carbamazepine 200mg tab 11. Amoxicillin 500mg capsule 12. Gliclazide 80mg tablet 13 Paracetamol suspension	1. Diazepam 5mg tablet 2. Insulin, Neutral Soluble 3. Amlodipine 5mg tablet 4. Amoxicillin + Clavulanic Acid 5. Atenolol 50mg tablet 6. Diclofenac 25mg tablet 7. Ferrous Sulphate + Folic acid 8. Fluoxetine 20mg tablet 9. Carbimazole 5mg tab 10. Artemether+ Lumefantrine 11. Artesunate 100mg tablet 12. Azithromycin suspension 13. Co-trimoxazole suspension 14Diclofenac 50mg tablet

Table 4. 23 Summary of individual Drug availability in private sector

Medicines not found in any outlets	No medicine
Medicines found in less than 25% of outlets	1. Salbutamol syrup 2. Salbutamol inhaler 3. Simvastatin 20mg tablet
Medicines found in 25 to 50% of outlets	1. Paracetamol tabs 500mg 2. Ranitidine 150mg tablet
Medicines found in 50 to 75% of outlets	1. Metronidazole 500mg tablet 2. Norethiesterone 5mg tablet 3. Nifedipine Retard 20mg tablet 4. Omeprazole 20mg tablet 5. Oral rehydration Salt 6. Paracetamol suspension
Medicines found in over 75% of outlets 1. Carbimazole 5mg tab 2. Cefixime 400mg capsule 3. Chloramphenicol eye drops 4. Ciprofloxacin 500mg tablet 5. Diazepam 5mg tablet 6. Diclofenac 25mg tablet 7. Ferrous Sulphate + Folic acid 8. Fluoxetine 20mg tablet 9. Co-trimoxazole suspension 10. Diclofenac 50mg tablet 11. Dexamethasone injection 12. Furosemide 40mg tablet 13. Glibenclamide 5mg tablet 14. Gliclazide 80mg tablet 15. Hyoscine -N-Butylbromide 16. Ibuprofen 400mg tablet 17. Insulin, Neutral Soluble 18. Lisinopril 10mg tablet 19. Metformin HCL 500mg tablet 20. Metronidazole 250mg tablet	21. Amitriptyline 25mg tablet 22. Amoxicillin suspension 23. Adult cough preparation 24. Albendazole 200mg tablet 25. Amoxicillin 500mg capsule 26. Amlodipine 5mg tablet 27. Amoxicillin + Clavulanic Acid 28. Amoxicillin + Clavulanic Acid 2 29. Artemether injection 30. Artesunate 50mg tablet 31. Atenolol 50mg tablet 32. Artemether+ Lumefantrine 33. Artesunate 100mg tablet 34. Azithromycin suspension 35. Atorvastatin 20mg tablet 36. Ceftriaxone injection 1g 37. Beclomethasone inhaler 38. Captopril 25mg tablet 39. Carbamazepine 200mg tab

Figure 4. 9 Summary of availability in the three sectors



The figure above summaries the availability of lowest price generics in the private, public and RDF sectors, it is clear that private sector has better availability, 38 items were found to have availability more than 75%, at the same time only 28 medicines were found to has that level of availability in the public sector and less than 20 medicines in RDF sector.

Figure 4. 10 The availability of selected medicines in all surveyed sectors

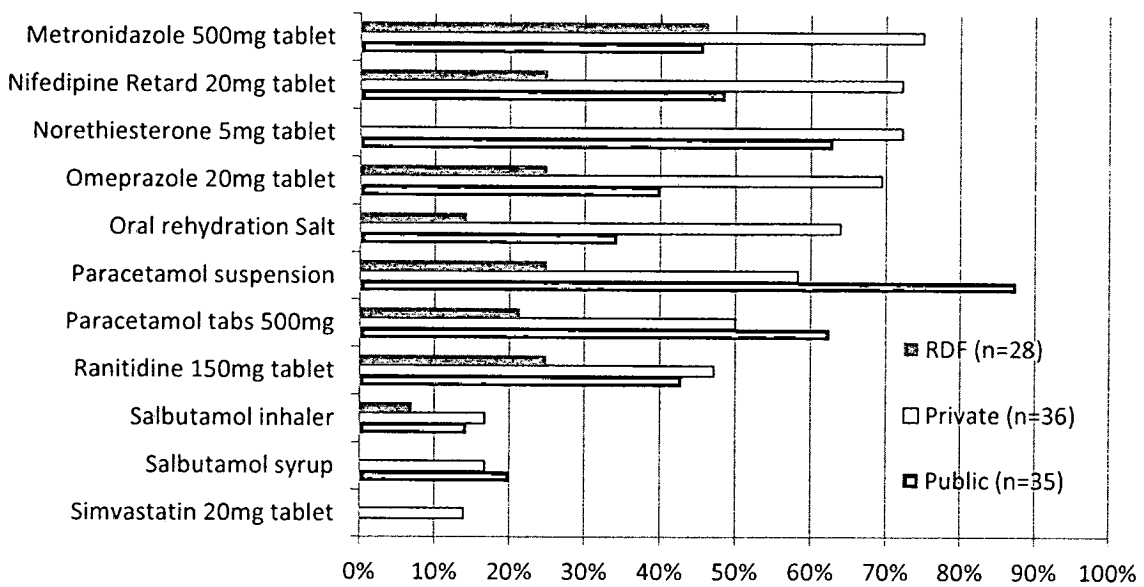
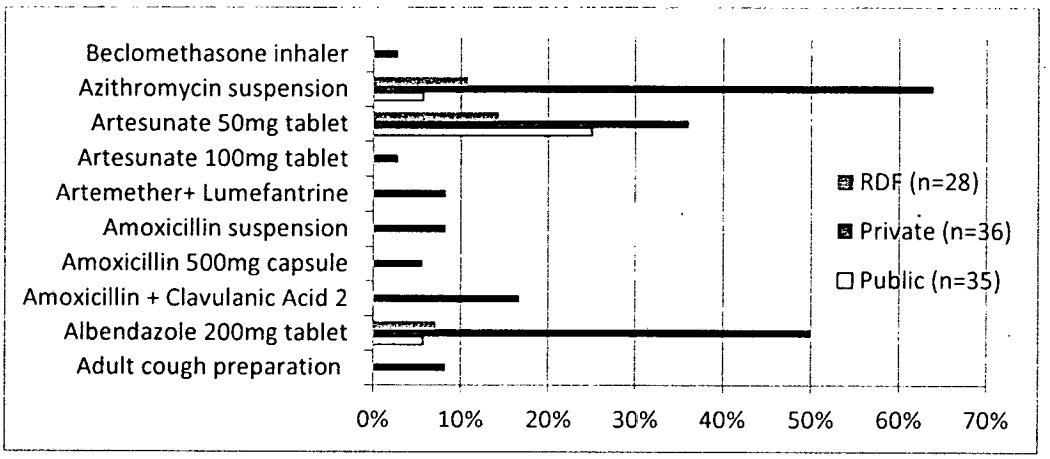


Figure 4. 11 The availability of selected brans in all surveyed sectors



4.4. Affordability of standard treatment

The affordability of treatment for 14 common conditions was assessed in term of days' wage of lowest paid government unskilled worker, for chronic disease full treatment course for one month, while for acute conditions full treatment course for the condition was assessed. The days' wage in local currency equal about 12 SDG.

Table 4. 24 Days' wages of the LPGW to buy treatment in all sectors

Disease condition and 'standard' treatment			Day's wages to pay for treatment		
Condition	**medicines**	**course of treatment**	LPG - public	LPG - private	LPG RDF
Asthma	Salbutamol inhaler	1 inhaler of 200 doses	1.6	1.4	-
Diabetes	Glibenclamide 5 mg cap/tab	1 cap/tab x 2 x 30 days = 60	0.5	0.8	0.8
Hypertension	Atenolol 50 mg cap/tab	1 cap/tab x 30 days = 30	0.7	0.5	0.5
Hypertension	Captopril 25 mg cap/tab	1 cap/tab x 2 x 30 days = 60	3.3	3.3	2.0
Hypercholesterolemia	Simvastatin 20 mg cap/tab	1 cap/tab x 30 days = 30	2.1	2.0	1.5
Depression	Amitriptyline 25 mg cap/tab	1 cap/tab x 3 for 30 days = 90	2.3	2.3	1.5
Adult respiratory infection	Ciprofloxacin 500 mg cap/tab	1 cap/tab x 2 for 7 days = 14	1.2	1.2	1.1
Pediatric respiratory inf.	Co-trimoxazole 8+40 mg/ml suspension	5ml twice a day for 7 days = 70 ml	0.4	0.5	0.4
Adult respiratory infection	Amoxicillin 500mg cap/tab	1 cap/tab x 3 for 7 days = 21	1.1	1.1	1.0
Adult respiratory infection.	Ceftriaxone 1 g/vial injection	1 vial	13.9	3.8	3.0
Anxiety	Diazepam 5mg cap/tab	1 cap/tab x 7 days = 7	0.1	0.1	0.1
Arthritis	Diclofenac 50mg cap/tab	1 cap/tab x 2 x 30 days = 60	5.3	4.9	4.8
Pain/inflammation	Paracetamol suspension	child 1 year: 120mg (=5ml) x 3 for 3 days = 45ml	0.3	0.3	0.3
Ulcer	Omeprazole 20mg cap/tab	1 cap/tab x 30 days = 30	2.7	2.5	2.3

The affordability in the public sector as shown in the result in the table above can be considered as poor. However some medicines were found to have days' wage lower than 1, these were, Adult respiratory tract infection using Ceftriaxone injection 1g (13.9), Arthritis treated with Diclofenac 50mg tablet cost (5.3) Asthma, Salbutamol inhaler (1.6), Hypertension, captopril 25mg tablet (3.3). and Hypercholesterolemia , Simvastatin 20mg tablet (2.1).

In RDF other public sector the affordability of lowest price generics was better than the other two sectors, but the availability in RDF sector is always questionable. However some treatments are likely higher than one days' wage of lowest paid government worker.

Treatment that cost one day wage of LPGW in the private sector, examples of such medicines and condition were; Arthritis treated with 50mg Diclofenac 50mg tablet (4.9 day wage), Adult respiratory tract infection treated with Ceftriaxone 1g injection (3.8 days' wages), Ulcer treated with Omeprazole 20mg cap/tab (2.5 days' wages) and Hypercholesterolemia treated with Simvastatin 20mg tablet (2.1 days' wages). But still in private sectors there were conditions that can be treated with less than one day wage like, anxiety 0.1 days' wages) and pediatric respiratory tract infections (0.5 of days' wages).

Treating same condition with OB, patients has to pay more days' wage to get them in the private sector. For example, treating Asthma with Salbutamol inhaler costs 2.5 of days' wages (1.4 for generic), while treating Hypertension with Atenolol 50mg tablet costs 5.2 of days' wages (0.5 for the generic). And treating adult infection with Amoxicillin + Clavulonic acid 1g cost 9.2 days' wage (5.1 for the generic).

In case families where more than one patients has to be treated, then more days' wages should be forgone, e.g. hypertensive and asthmatic father on Captopril 25mg and Salbutamol inhaler and asthmatic child on Salbutamol inhaler as well, such family has to pay 6.5 days' wage to get their 30 days treatment from the public sector

Figure 4. 12 Affordability to treatment for common diseases

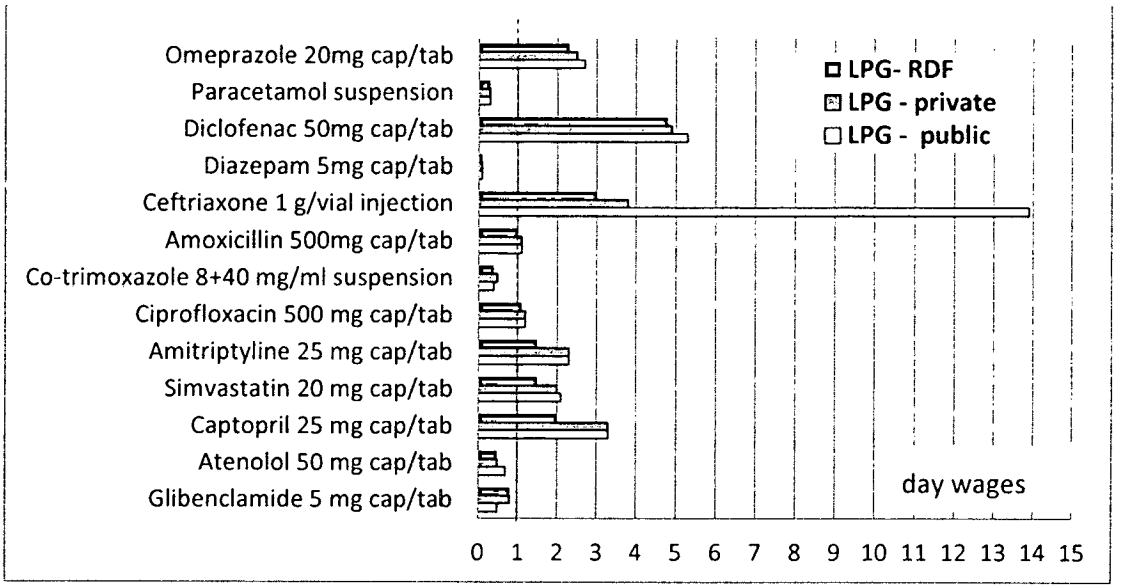


Table 4. 25 Day wages required for malaria treatment

medicines	Days' wages required		
	public sector	private sector	RDF sector
Artemether 80mg injection	2.8	3	2.6
Artemether + Lumefantrine tab	1.1	3.3	-
Artesunate Adult 100mg tab	1.3	1.3	1.2
Artesunate child 50mg tab	1.0	0.8	0.8

In 2005 a report of systemic analysis (Ewen, Laing, Nouguchi, & Gelders, 2006) revealed that variety of MPR of Glibenclamide in 7 countries, when the MPRs from these countries compared to Sudan (result from this study) Sudan seemed a little bit higher even from neighboring country like Chad. (See figure 4.13).

This variations in MPRs between the three sectors is mainly due to fact that each sector has it is own objectives, public sector which mainly NHIF medicines outlets seems mark high prices by more than 5% in LPG over the private can align with NHIF objective which is to contain cost of services.

RDF charge prices lower by 10% to 11% when compare to the public and private sector is aligning with the RDF objective to ward accessibility. However the availability in this sector which will be discussed later is questionable.

Average availability in the private sector was good at 83.9%. for generics medicines. In the private sector, medicine availability was higher than that of the other two public sectors. [The availability of individual medicines in public, RDF and private sectors in appendix L]

In the public sector, medicines with particularly low availability include Salbutamol inhaler (14.3%), Salbutamol syrup (14.3%), Simvastatin (0.0%).

Artemether 80mg injection (LPG) used as second line for malaria treatment in adult require 2.8 days' wage in the public sector and 3 days' wage in the private and 2.5 in the RDF (see Table 4.25). Compare to surveys conducted in 2004 the affordability of Salbutamol inhaler in in the private sector Uganda was 5.6 days for the brand and 2 days for LPG, while in Ghana was 8 days (IB) and 4.6 days (LPG) and in Mali the affordability was 4.2 days for the IB and 2.7 for the LPG (WHO/HAI, 2008b)while in Sudan is less than two days' wage (1.6 days in the public sector, 1.4 days in the private sector) and only 3.1 days, 2.5 days for the IB in the public and private sectors respectively.

In WHO/EMRO where Sudan is part of found in 2009 the affordability of Glibenclamide 5mg tabs was 2.1 days (IB, private), 0.9(LPG, private) and 0.5 (LPG, public) (Cameron, Ewen, Ross, et al., 2009) compare to Sudan these figures a little bit lower in the region than Sudan.

A report review 2005 (Ewen et al., 2006) reviewing the prices availability and affordability of chronic medicines, comparing days' wage for Beclomethasone inhaler to the all countries appeared in figure IV- 11, LPG Beclomethasone inhaler in Sudan seems not so far different from those countries despite the economic variations between these countries. Although Lebanon, India (Chinnai) and Kenya seemed a little bit lower than 2 days' wage.

4.5. Factors affecting medicine prices

According to the model developed to analyze the effect of various factors mentioned in table 4.26 below, the dependent variable was the medicines' price ratio between the Capital and other states (Ps/Pc), Gretle was used to estimate coefficients

	River Nile	W. Darfur	Red Sea	Gazeera	Sinnar	Khartoum
Median MPR	(2 meds)	(0 meds)	(6 meds)	(4 meds)	(2 meds)	(9 meds)
Originator brand	2.82	--	4.9	7.8	7.02	3.47
Median MPR	(44 meds)	(36 meds)	(45 meds)	(41 meds)	(46 meds)	(45 meds)
Lowest price generic	3.06	3.71	3.01	2.84	2.86	2.61
Difference public to RDF	- 2.8 %	44.2%	15.3%	17.1%	- 11%	12%
Difference private to RDF	26.0%	29.1 %	15.3	03.6%	- 9.6%	- 4.7%
Difference public to procurement	65.0%	127.2%	93.3%	54.3%	86.8%	93.1%

Table 4. 26 Regression Result

Variables	*Coefficient*	*Std. Error*	*t-ratio*	*p-value*	
Const	1.0117	0.1609	6.2868	0.00000	***
State1	2.7789	1.2682	2.1912	0.0285	**
State2	0.3128	0.1772	1.7651	0.0776	*
State3	0.5537	0.2731	2.0272	0.0427	**
State4	1.5481	0.7134	2.1699	0.0301	**
State5	0.0930	0.0270	3.4392	0.0006	***
Sector2	0.0443	0.0646	0.6853	0.4932	
Sector1	0.1138	0.0616	1.8475	0.0648	*
Distance	0.0023	0.0009	2.5354	0.0113	**
type	-0.1647	0.1150	-1.4319	0.1523	
Site	0.0685	0.0844	0.8116	0.4171	
sour	0.0681	0.0694	0.9821	0.3261	
R-squared	0.089838	Adjusted R-squared	0.087043		

As shown in table 4.26 above the result of regression, all states have significant effect on the price ratio, state1 which is West Darfur the farthest state from the capital has the highest effect coefficient, meaning that; the highest variation of medicine prices. State4 (Red Sea) which is the second state after West Darfur in term of how far from the capital 675km far, so; moving from capital to state4 the price ratio increase by 1.55 times. While state3 (Sinnar) which is 310km far, it found the price ratio increase by 0.55 time. Then state2 (Gazeera 186km) the price ratio found to increase only by 0.31 time from the capital. But state5 (River Nile 310km) appeared to has the least effect between all states on price ratio which was only 0.09 times.

Sector1 was private show that moving from public to private cross capital and states will increase the price ratio by 11.4%, while sector2 which is insignificant due to the fact that RDF as sector with common objectives in all states where to contribute

to increase medicines accessibility and improve affordability, that is why no significance differences between the capital and other states in this sector.

Also the distance found to has significant coefficient and as moving from capital to the remote moving 1km from Khartoum will increase the price ratio by 0.23%.

4.6. Discussions

4.6.1. Medicine prices

The retail price of medicines in the public sector for lowest price generics is 2.98 times their international reference prices, and higher than the private sector (2.9) and RDF (2.7), the public sector here mainly NHIF medicines outlets, NHIF purchase medicines at price 1.84 times international reference prices, and retailed to their clients at price higher than their procurement price by 62.4%. But NHIF clients are forced to get their medicine from NHIF medicine outlets paying co-payment of 25% of the total cost of the medicines. Increasing profit margin meaning that NHIF medicines cost will be less than 75%.

The way social health insurance in Sudan containing medicines cost to face very low premium from high risky people, it is also efficient way to collect indirect premium, especially from those who get free insurance card. Secrets behind the public sector (mainly NHIF facilities have higher prices than the private sector).

The RDF which is also public sector, but their mission objectives is to improve essential medicines access and affordability, the medicines priced at very low rate in RDF facilities, only 41.9% higher than the government procurement prices.

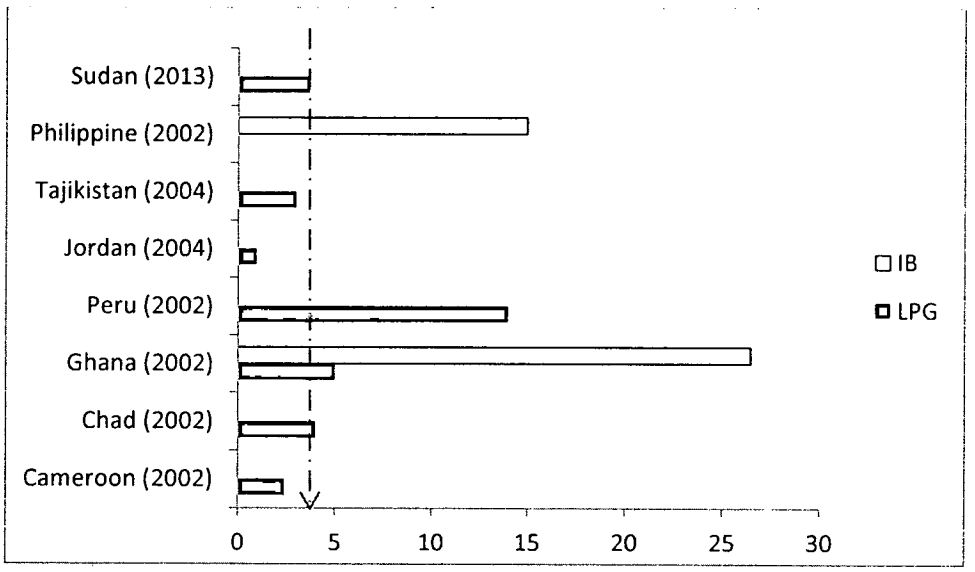
The significance variations in medicines price among states, is reasonable, because Sudan is very big country, no paved roads in many states, therefore, there is transportation cost, e.g. the private sector in West Darfur the farthest state, medicines were priced at 3.71 times their international reference prices compare to Khartoum state, the capital the medicines were retailed at price 2.61 times international reference price (the minimum median price ratio). Gazeera state which is the nearest state to the capital medicines were price at 2.84 times their international reference price.

In Table 4.13 below, the MPR of Glibenclamide 5mg tablet was compared among different countries, the comparison shows that Sudan and Chad almost the

same in MPR of Glibenclamide 5mg, while in Cameron, Jordon and Tajikistan, the MPR is lower than Sudan.

The far the state the highest price ratio will be observed, State like West Darfur, where no paved road, the cost of transportation is found to be high, there for the medicine's prices are high. But states like Gazeera and River Nile, the nearest state to Khartoum, and the transportation cost is low, there for medicines were sold in low prices compared to West Darfur and Red Sea.

Figure 4. 13 MPRs of Glibenclamide in public sector in selected countries



4.6.2. Medicines availability

Despite of better prices offered by the RDF sector, but the availability in this sector is low (55.4%) compared to the private and RDF sectors 83.9% and 68.2% respectively. Given advantages of good prices by RDF unfortunately not accompanied by good availability, patients are forced to get some medicines in higher prices in other public and private sectors.

Although the 1st line antimalarial agents now found to be free, but still the availability of the free treatment is under question, the availability of for-retail anti-malarias is very high, e.g. the availability of the 2nd line anti-malarias Artemether injection 80mg found in the public, private and RDF sectors was 100%, 97% and 82% respectively, Artemether + Lumefantrine tablets 77.1%, 97.2% and 82.1% respectively, while the availability of the 1st line Artesunate 100mg adult and

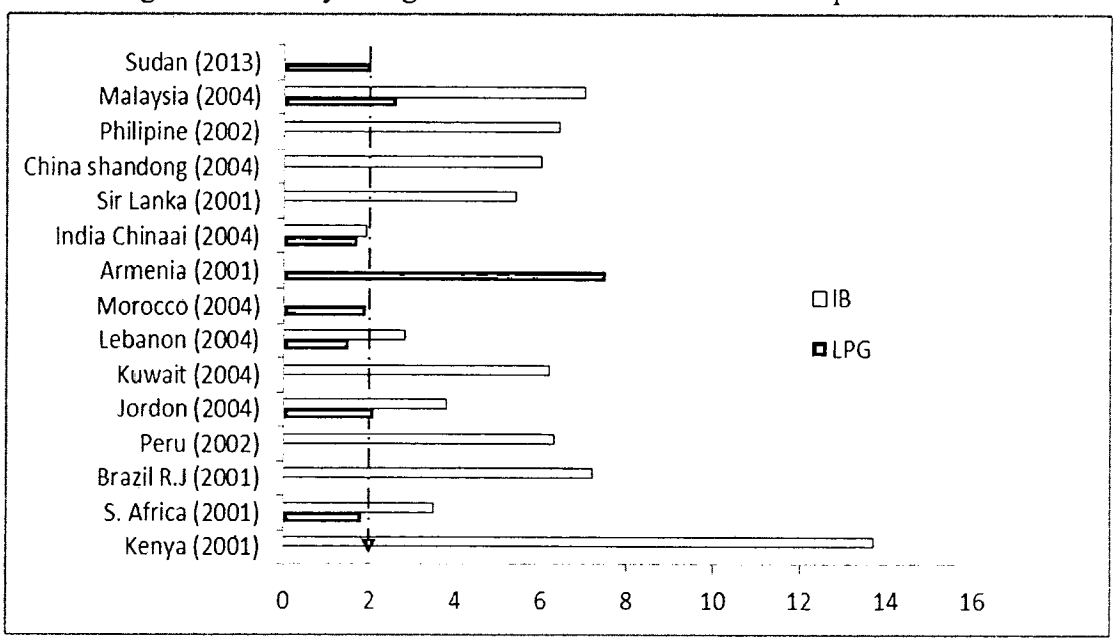
Artesunate 50mg children were 77.1%, 97.2%, 78.6% for the former and 100%, 97%, 75% for the later respectively in the three sectors.

4.6.3. Treatment affordability

Generally treatment of common disease in Sudan were not affordable, In case families where more than one patients has to be treated, then more days' wages should be forgone, e.g. hypertensive and asthmatic father on Captopril 25mg and Salbutamol inhaler and asthmatic child on Salbutamol inhaler as well, such family has to pay 6.5 days' wage to get their 30 days treatment from the public sector, which is extremely hard to such family. Malaria which is common disease in Sudan, in many cases two or more of family member will infected by disease, 2.6 days' wages required to purchase Artesunate 100mg tablet for two patients.

In Table 4.14 below, the affordability to treat asthma with Beclomethasone Inhaler in different countries when compared to Sudan, the days' wages needed in Sudan is almost similar to many countries like, India (Chennai), Morocco, Jordan and South Africa for the lowest price generic.

Figure 4. 14 Days' wage for Beclomethasone inhaler in private sector



4.6.4. Limitations of this study

The prices surveyed in this study are the retail price at the pharmacies, no analysis to the real cost behind which high medicines price in Sudan hide, neither the prices component.

The availability mentioned here, is at the time of survey, but assessment of the whole supply system in public and private sector is of significant importance, to gather factors influence medicines supply.