

ORIGINAL ARTICLE

Market Survey and Assessment of the Demand for Amoxicillin 500 mg Capsules in SudanElawad Mohammed¹, Abdelkarim M. Abdekarim¹, Murtada A. Oshi¹, Muhammad Naeem²**ABSTRACT**

Objective: To determine the current supply and demand for Amoxicillin 500 mg capsules at the pharmaceutical market level based on readily available and comparative data methods.

Study Design: Cross-sectional.

Place and Duration of Study: The study was carried out at hundred pharmacies spread throughout the three cities of Khartoum State (Khartoum, Omdurman, and Khartoum-North) from April 4th, 2018 to June 17th, 2018.

Materials and Methods: A market survey was conducted by visiting 100 pharmacies and basic questions were posed directly to the pharmacist about the annual sale of Amoxicillin 500 mg capsules through a questionnaire. The data was analyzed using the consumption process, and the projected actual demand for amoxicillin 500 mg capsules up to the year 2027 in Sudanese markets was estimated.

Results: The analyzed data showed a difference of about 756 million capsules between the current supply and real demand of 500 mg capsules of amoxicillin up to 2027. Moreover, the findings showed that there are substantial variations in annual sales of amoxicillin 500 mg capsules among the three cities where the survey was performed.

Conclusion: The results of this study can be used as a guide for estimating the actual demands for Amoxicillin 500 mg capsules in the Sudanese pharmaceutical market for the future.

Key Words: *Amoxicillin, Actual Supply, Medicines, Real Demand, Sudan.*

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Introduction

Sudan is the third-largest country (by area) in the African continent after Algeria and Democratic Republic of Congo, with an area of 1,886,068 km. It is culturally and ethnically diverse with approximately 500 tribal groupings speaking over 130 languages.¹ The country is constructed from 18 states, which are distributed in 5 geographic regions: Northern, Eastern, Western, Southern and Central.² Khartoum, Omdurman and Khartoum North are located in the

central state at the confluence of the Blue and White Niles and together these cities form the triple capital of the country. The national capital has an area of 22,122 km² and an estimated population of approximately 7,152,102, according to the latest population census in 2013. The population number of Khartoum state is roughly equal to a quarter of the total population in the whole country.³

The medicines and pharmaceuticals supply in Sudan is controlled by the federal and state Departments of Pharmacy. These governmental agencies work together to ensure that medicines and pharmaceuticals are fulfilling safety standards and affordable to all. To implement all these requirements, these departments use a vigorous system of medicine registration and pharmacy premises licensing.⁴

Like other sub-Saharan countries, the demand for medicines in Sudan has been increasing over the last two decades. Although it is a natural consequence of

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the country's population growth, the high demand for medicine is might be due to the increasing numbers of local pharmaceutical manufacturers and pharmacies across the country. Moreover, this might reflect the population's financial ability to purchase medicines and the availability of improved health supplies.⁴ This has generated an additional burden to federal and state Departments of Pharmacy to create effective tools for assessing the real demands of medicines and drug supply in the country.⁴⁻⁶

Infection is considered as the most important contributor to human morbidity and mortality until recent times. Amoxicillin, a chemical modification of ampicillin, belongs to a beta-lactam antibiotic group. It is an acid-stable, semi-synthetic drug. It has broad-spectrum activity against both gram-positive and gram-negative bacteria with a variety of clinical uses. Amoxicillin was effectively used to treat infections in the ear, nose, throat, lower respiratory tract, and urinary tract.⁷ The reason amoxicillin is a highly prescribed antibiotic is its favorable pharmacokinetic properties such as good oral absorption compared to other types of beta-lactam antibiotics.^{8,9}

The objective of this study is to calculate the actual supply and real demand for amoxicillin 500 mg capsules, to provide the pharmaceutical market clear descriptions of each demand segment (size, needs, profitability and competition).

Materials and Methods

The market survey was conducted by visiting 100 pharmacies within Khartoum State (Khartoum, Omdurman and Khartoum-North). The geographic distribution and the number of pharmacies in the three main cities were as follows: 40 pharmacies in Khartoum, 40 pharmacies in Omdurman, and 20 pharmacies in Khartoum-North. In this study, all factors were considered during the market survey such as type of pharmacy (both governmental and private sectors pharmacies were visited equally); location (both pharmacies in the middle and around the cities were visited equally), and population density. To collect accurate data, questions were asked directly to pharmacists through a simple questionnaire. The questions were related to the annual sales of amoxicillin 500 mg capsule and whether amoxicillin is dispensed with a medical prescription.

Results

Collection and Analysis of Data

The sale per year for amoxicillin 500 capsules from sample pharmacies in the Khartoum state were collected. The obtained data were tabulated (Table 1 and Figure 1). To assess the real demand for amoxicillin 500 mg capsule per year in the whole country, the obtained data were analyzed by using the consumption method. The total consumption of other states was estimated to be equal to the Khartoum states consumption: The consumption of

Table 1: Annual sale of amoxicillin 500 capsules in the three cities of the Khartoum state

No.	Pharmacy Code	Amoxicillin 500 mg capsules bought per year		
		Khartoum	Omdurman	Khartoum-North
1-3.	A.	25,200	21,700	36,500
4-6.	B.	18,250	22,100	21,900
7-9.	C.	36,500	14,600	25,550
10-12.	D.	18,250	14,600	29,200
13-15.	E.	72,00	25,600	43,800
16-18.	F.	43,800	25,500	18,350
19-21.	G.	58,400	36,500	18,150
22-24.	H.	62,050	51,100	18,250
25-27.	I.	54,700	54,750	10,950
28-30.	J.	10,950	14,600	18,300
31-33.	K.	18,250	18,245	10,900
34-36.	L.	29,200	25,555	14,600
37-39.	M.	62,000	18,250	10,950
40-42.	N.	18,250	73,000	36,500
43-45.	O.	29,200	18,250	7,200
46-48.	P.	18,000	14,600	7,400
49-51.	Q.	25,550	21,600	29,200
52-54.	R.	29,200	58,400	36,500
55-57.	S.	29,400	14,600	26,550
58-60.	T.	29,000	14,650	24,550
61-62.	U.	25,500	25,550	NA
63-64.	V.	11,000	25,550	NA
65-66.	W.	14,600	10,950	NA
67-68.	X.	29,200	43,800	NA
69-70.	Y.	10,950	10,900	NA
71-72.	Z.	25,550	18,300	NA
73-74.	AA.	21,900	18,250	NA
75-76.	BB.	22,000	14,600	NA
77-78.	CC.	25,450	43,800	NA
79-80.	DD.	14,600	52,050	NA
81-82.	EE.	14,700	54,700	NA
83-84.	FF.	25,450	62,100	NA
85-86.	GG.	10,950	25,555	NA
87-88.	HH.	25,550	18,250	NA
89-90.	II.	11,000	54,650	NA
91-92.	JJ.	36,400	62,100	NA
93-94.	KK.	47,450	43,800	NA
95-96.	LL.	73,00	62,050	NA
97-98.	MM.	43,800	25,550	NA
99-100.	NN.	18,250	7,300	NA
Total		1,316,100	1,787,500	400,700

NA: Not Available

Khartoum state is 50% of total consumption of the country.

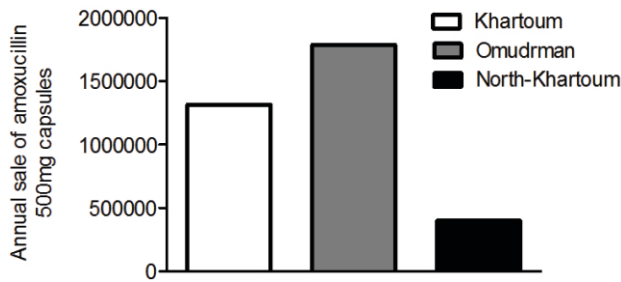


Fig 1: Annual sale of amoxicillin 500 capsules of the Khartoum state three cities

Calculation of Consumption

For Khartoum State:

The total annual sale of amoxicillin 500 mg capsules= Total annual sale of Khartoum + Total annual sale of Omdurman State + Total annual sale of Khartoum North State: 1,316,100 + 1,787,500 + 400,700 = 3,504,300 capsules.

The number of pharmacies in Khartoum State = 1550
 The sale of amoxicillin 500 mg capsules of one pharmacy = total annual sales / number of pharmacies: 3,504,300/1,550 = 2260.

Total consumption = sales of amoxicillin 500 mg capsules per year X total number of pharmacies: 35,043 X 1,550 = 54,316,650 capsules.

For other States

The total consumption of other States is estimated to be equal four times of Khartoum State consumption: 54,316,650 X 2 = 108,633,300 capsules.

For all States including Khartoum State

The total consumption of all States = Total consumption of Khartoum States + The total consumption of other States: 54,316,650 + 108633300 = 162949950 capsules per year.

To cover unreported cases, a value of 10% from the total sale was added to total consumption 162,949,950 + 16.294,995 = 179,244,945 capsules.

Calculation of the Real Demands

World Health Organization (WHO) recommended a minimum of US 12 \$ for individual consumption, while the actual consumption by the Sudanese citizen is equal to only US 3 \$ as documented by the Ministry of Health-WHO recently.^{10,11}

To reach the minimum level of consumption recommended, the total sale obtained is multiplied by factor 4.

The real demand is the total consumption in Sudan

multiplied by a factor (4): 179,244,945 X 4 = 716,979,780 capsules for (2018).

Demand projection

Calculation of the real demand of amoxicillin 500 mg capsules for the following 10 years was estimated for 10 years by taking 3% as the population growth rate (Table 2).

Table 2: Real demand for amoxicillin 500 mg capsules for the coming 10 years

No	Years	The Real Demand
1.	2018	716,979,780
2.	2019	738489173
3.	2020	760643848
4.	2021	783463163
5.	2022	806967058
6.	2023	831176070
7.	2024	856111352
8.	2025	881794693
9.	2026	908248534
10.	2027	935,495,990

Demand Analysis

The total gap of amoxicillin 500 capsules between the real demand and actual supply can be calculated as follows:

The total gap = Demand project (2022) - Total Supply: 935,495,990 – 179,244,945 = 756,251,045 capsules.

Discussion

Amoxicillin is classified as a prescription-only drug (POD) that can be only dispensed by medical prescription. However, in the majority of developing countries, it is dispensed without medical prescription as over the counter drug (OTC). OTC drug list includes drugs with minor side effects, which can be tolerated by the patients. The list of OTC drug varies from country to country. In Sudan and like other developing countries, amoxicillin is dispensed without a medical prescription by pharmacists in the community pharmacies to a large extent. Unfortunately, this irrational antibiotic consumption make bacteria resistant.^{9,12}

The supply of amoxicillin 500 mg capsules is dependent on the quantity in stock. In addition to other factors, the price of medicine is a key factor linked to the supply and consumption. When the price is less, more people can buy them, and the supply (stock in pharmacy stores) decreases. When the price is high, fewer people buy them while the supply remains high, thus more drugs remain on the shelves of pharmacies. In Sudan, the full course of

the amoxicillin 500 mg capsules price is about \$US 2, which makes it affordable for the majority of patients, and this was reflected in the survey result as a high annual sale of it by each pharmacy (Table 1).

According to the projected estimates of this study for the year 2027, there is a gap of 756,251,045 capsules of amoxicillin 500 mg between the market's demand and actual supply. This means that the real demand for amoxicillin 500 mg capsules in the Sudanese pharmaceutical market will be greater than the actual supply. In a country like Sudan, pharmacists and their assistants often dispense POD drugs, like amoxicillin, to patients without a medical prescription. According to the finding of this study, the high overall antibiotic consumption might be one of the major causes of antimicrobial resistance in the future. To solve the issue of high antibiotic consumption, community pharmacists should counsel patients against the use of antibiotics in viral illnesses¹³ and on the importance of compliance. A qualitative study should be conducted to understand and control the dispensing practices and behavior of amoxicillin 500 mg capsules by community pharmacists for implementing policy interventions that would protect the use of this important antibiotic at the community level in Sudan. The outputs can answer the critical questions about the regulations on prescribing and dispensing behavior commercial interests; activate advisory role and how we can put intervention strategies for rational use of antibiotics in general and amoxicillin 500 mg capsules in particular.

According to the findings in this study, there is a shortage of amoxicillin 500 mg capsules supply in the Sudanese pharmaceutical market. This can be done by increasing the local production of amoxicillin 500 capsules by building new pharmaceutical industries. However, this is expensive for a developing country like Sudan. Another easier solution for this issue is educating people about the danger of irrational using antibiotics in general and amoxicillin 500 capsules in particular, for their health. This essentially needs the involvement of doctors, hospital and community pharmacists, patients and drug regulatory government authorities.

Conclusion

Antibiotics shortages have been growing in Sudan and can have an alarming impact. Collective efforts

to overcome this shortages must be made by the health professional and government agencies. Pharmacies should not give antibiotics without a doctor's prescription and also educate patients about the proper use of the recommended dose. Government legislators and regulators agencies should establish strategies with local pharmaceutical manufacturers to enhance quality production and maintain demand-supply to the pharmacies.

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