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## Original Research Article

### Antibiotics Consumption in the Eastern Region of Libya 2012-2013.

*Khalifa A.A.<sup>1</sup>, Bukhatwa S.A.<sup>2&\*</sup>, Elfakhri M.M.<sup>3</sup>*

*1 Department of Pharmacy Practice, Faculty of Pharmacy, Libyan International Medical University, Benghazi, Libya.*

*2 Department of Pharmacology & Toxicology, Faculty of Pharmacy, University of Benghazi, Benghazi, Libya.*

*3 Department of Biochemistry, Faculty of Medicine, University of Benghazi, Benghazi, Libya.*

*\* Corresponding author: Salma A. Bukhatwa. Mobile: 00218917975153, E-mail: [salma.bukhatwa@uob.edu.ly](mailto:salma.bukhatwa@uob.edu.ly).*

#### ABSTRACT:

**Background:** Drug utilization studies conducted in Libya during the period 1991-2013, have pointed out the irrational use of antibiotics as a common practice that costs the health system more than 7.7 million Libyan Dinars / year. The aim of this study is to assess the trend of antimicrobial consumption in the Eastern region of Libya during 2012 – 2013.

**Methods:** Antimicrobial consumption data from the years 2012 and 2013 were obtained mainly from Benghazi office, Medical Supply Organization (MSO; the only official drug-importing body in Libya). This study is concerned with antibiotics imported only to the Eastern region of Libya, population of which represents approximately 35% of total Libyan population. The WHO, Anatomical-Therapeutic-Chemical (ATC) classification and the Defined Daily Dose (DDD) methodology were used to calculate antibiotic consumption. The total antimicrobial consumption data were calculated as DDD/1000 inhabitants/day.

**Results:** Total utilization of antibiotics decreased dramatically from 15.47 DDD/1000 inhabitants/day in 2012 to 4.30 DDD/1000 inhabitants/day in 2013 which in turn shows a significant decline compared to 41.72 DDD/1000 inhabitants/day during the period 1991-1993. Consumption of penicillins decreased from 19.902 DDD/1000 inhabitants/day during 1991-1993 to 1.896 DDD/1000 inhabitants/day during 2012-2013 with pattern of amoxicillin/clavulanic acid consumption equals to 3 times ampicillin consumption and is the highest compared to all penicillins. This was accompanied by a prominent increase in consumption of amphenicols and fusidic acid during 2012-2013 noting that fusidic acid consumption was the highest among all antibiotics.

**Conclusion:** MSO since 2011 (post 17th February 2011 revolution) lost its control on importing medicines due to receiving many drugs as donations from different international sources without acceptable level of coordination. This has been reflected on drug purchasing policy of MSO during 2013,

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which failed to regain the previously accepted level of DDD/1000 inhabitants/day antibiotics consumption. The decreased consumption of penicillins together with increased consumption of amphenicols and fusidic acid complies with the pattern of antibiotic resistance reported previously in Libya. Similar studies should be conducted to evaluate national drug consumption under normal conditions to be compared with regional and international data.

**Keywords:** Libya; healthcare; defined daily dose; fusidic acid.

## INTRODUCTION

A drug classification system represents a common language for describing the drug assortment in a country or region and is a prerequisite for national and international comparisons of drug utilization data, which have to be collected and aggregated in a uniform way [1].

Drug Utilization Research (DUR) is defined by WHO as "The marketing, distribution, prescription and use of drugs in society, with special emphasis on the resulting medical, social and economic consequences" [2].

The Defined Daily Dose (DDD) can be used as a unit for measurement of drugs consumption. DDD is the assumed average maintenance dose per day for a drug used for its main indication in adults [2]. The DDD methodology was developed in Scandinavian countries in the late 1970s and is now internationally adopted and supported by WHO. It should be emphasized that the DDD is a unit of measurement and does not necessarily correspond to the recommended or Prescribed Daily Dose (PDD). The DDD is often a compromise based on a review of the available information about doses used in various countries. Drug utilization figures should ideally be presented as numbers of DDDs per 1000 inhabitants per day or, when drug use by inpatients is considered, as DDDs per 100 bed-days. For anti-infectives (or other drugs normally used for short periods), it is often considered to be most appropriate to present the figures as numbers of DDDs per 1000 inhabitants per day. All the drugs consumed in Libya are imported except few items, which are manufactured locally. The headquarters of the National Company of Pharmaceutical Industry

(NCPI) was in Tripoli and until 2004 was responsible for all drug manufacture and imports in Libya. its branches are the channels of drugs distribution for governmental hospitals & private pharmacies and clinics.

On 2004 till date the Libyan Secretariat of Health by executing a public tender through Medical Supply Organization (MSO) has become responsible for purchasing and distribution of drugs to public hospitals and clinics. Worth noting that on sporadic intervals a budget has been allocated to major public hospitals to locally purchase their own general drug demands. However, during the last seven years the MSO Benghazi's branch has been hold responsible of serving the whole public sector of the Eastern region of Libya. The population of this region is about 1,807,336 million - according to the last population census 2006 - mostly concentrated at the coast [3]. Drug Utilization Studies (DUS's) conducted during the period 1991–2013 in Libya, have pointed out the irrational use of antibiotics as a common practice that costs the health system more than 7.7 million Libyan Dinars/year (unpublished data obtained from MSO).

This study discusses policy of rational use of antibiotics in the Eastern region of Libya via quantitative determination of antibiotics utilization.

## METHODS AND MATERIALS

### SOURCES OF INFORMATION

#### 1) Main store of the General Secretariat of Health in Benghazi

Data obtained from the store included tenders' requirements, imported quantities, consumed, expired, stock and drug inventory for the years;



2012 & 2013, this of course in addition to quantities of drugs issued periodically to each health facility.

## **2) Medical Supply Organization (MSO)**

MSO is the only body responsible for the drug supply to public health institutions in the Eastern province. Some of the obtained information was made available by MSO Technical Department while the rest had been collected from existing drug stores within the public health centers which are enrolled in this study.

### **DATA COLLECTIONS AND CALCULATIONS**

#### **1) Drug Import to the Eastern region of Libya**

Total amounts of drugs imported and consumed annually during the two years of the study were obtained by adding up the figures from stores of the NCPI and stores of MSO as both stores complement one another in supplying drugs to the Eastern region of Libya, for both private and public sectors respectively. Imported drugs in the present study included drugs that were actually received and delivered to the stores.

#### **2) Drug consumption in the Eastern region of Libya**

The amounts of drugs consumed in all Eastern region of Libya were obtained from the records of the Secretariat of Health stores and from the stores of the NCPI.

Figures for regional annual sales were calculated by adding inventory figures of drugs remaining in stores from previous year to the amounts of drugs imported during the studied year minus drugs remaining at end of that particular year including expired drugs. These sales figures plus the distribution figures obtained from stores of the Secretariat of Health constituted total annual drug consumption for the Eastern region of Libya, as shown in the equation:

***Annual drugs sales = (drug remaining from previous year + drug imported the study year) - (drug remaining from the study year + drug expired the study year).***

Calculation of consumption of antibiotics as DDD/1000 inhabitant /day is calculated from the following formula [4].

$$\frac{\text{Amount of drug imported or consumed in a year (in mg)}}{\text{DDD(mg)} \times 365 \text{ days} \times \text{number of inhabitants}} \times 100$$

### **RESULTS:**

Total utilization of antibiotics decreased dramatically from 15.466 DDD/1000 inhabitants/day in 2012 to 4.332 DDD/1000 inhabitants/day in 2013 (Table 1).

The total consumption of antibiotics was dramatically decreased in 2012-2013 by 31.816 DDD/1000 inhabitants/day compared to 1991-1993 (Table 2).

Penicillins, sulfonamides and tetracyclines represented 50.34, 13.64 & 12.16% respectively of total antibiotics consumed during 1991-1993 in Eastern region of Libya (Table 3). Meanwhile penicillins, tetracyclines and amphenicols represented 26.71, 23.06 & 14.45% respectively of total antibiotics consumed during 2012-2013 in the Eastern region of Libya (Table 3).

Ampicillin represented 97.4% of all penicillins consumed during 1991-1991, but its use was reduced to 11.88% among all penicillins consumed during 2012-2013 (Table 4). Amoxicillin and amoxicillin/clavulanic acid combination represented 1.35 & 1.22% respectively of all penicillins consumed during 1991-1993, but their use was increased to 26.37 & 37.97% respectively of all penicillins consumed during 2012-2013 (Table 4).

In addition, ampicillin represented 37.23% of all antibiotics consumed during 1991-1993, but its use was reduced to 2.58% among all antibiotics consumed during 2012-2013 (Table 4). Amoxicillin and amoxicillin/clavulanic acid combination represented 0.52 & 0.47% respectively, of all antibiotics consumed during 1991-1993, but their use was increased to 5.15 & 7.27% respectively, among all antibiotics consumed during 2012-2013 (Table 4).

Noting that fusidic acid represented 38.25% of all antibiotics used during 2012-2013 and hence

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its consumption was the highest among all antibiotics used in 2012-2013 (Table 4).

**Table 1: Utilization of antibiotics in the Eastern region of Libya during the years 2012 & 2013.**

Drug group according to ATC system	DDD/1000 inhabitants/Day	
	2012	2013
<b>JO1A-Tetracyclines</b>		
Doxycycline	-	1.83
Tetracycline	0.42	0.05
<b>Total (%)</b>	<b>0.42 (2.71)</b>	<b>1.88 (43.4)</b>
<b>JO1B- Amphenicols</b>		
Chloramphenicol	4.47	-
<b>Total (%)</b>	<b>4.47 (28.9)</b>	
<b>JO1C-Penicillins</b>		
Amoxicillin	0.39	0.63
Ampicillin	0.30	0.21
Amoxicillin + Clavulanic acid	0.72	0.72
Benzathine Penicillin	0.01	0.10
Penicillin G	0.18	0.06
Flucloxacillin	0.40	0.002
Cloxacillin	0.05	0.02
<b>Total (%)</b>	<b>2.05 (13.2)</b>	<b>1.742(40.21)</b>
<b>PO1D- Quinolones</b>		
Levofloxacin	0.002	0.002
Ciprofloxacin as lactate	0.007	0.01
<b>Total (%)</b>	<b>0.009 (0.05)</b>	<b>0.012 (0.27)</b>
<b>JO1E- Macrolides</b>		
Erythromycin	0.41	0.14
Clarithromycin	0.01	0.0001
<b>Total (%)</b>	<b>0.42 (2.71)</b>	<b>0.14 (3.23)</b>
<b>JO1F-Cephalosporins</b>		
Ceftriaxone sodium	0.27	0.0007
Cephalexin	<b>0.03</b>	0.15
Cefotaxiem sodium	0.02	0.058
<b>Total (%)</b>	<b>0.32 (2.06)</b>	<b>0.209 (4.82)</b>
<b>JO1G- Aminoglycosides</b>		
Gentamycin Sulphate	0.19	0.13
Amikacin	0.013	0.026
<b>Total (%)</b>	<b>0.203 (1.31)</b>	<b>0.156 (3.60)</b>
<b>JO1X- Other Antibacterial drugs</b>		
Vancomycin	0.003	0.18
Fucidic acid	7.57	0.001
Clindamycin	0.0005	0.01
<b>Total (%)</b>	<b>7.574 (48.9)</b>	<b>0.193 (4.45)</b>
<b>End Total</b>	<b>15.466</b>	<b>4.332</b>



Table 2: Comparison of Antibiotics consumption in the Eastern region of Libya during the periods (1990-1993) & (2012-2013).

<i>Drug group according to ATC classification</i>	<i>Average DDD/1000 inhabitants/day</i>		
	<i>1991-1993</i>	<i>2012-2013</i>	<i>Difference in DDD</i>
<b>TETRACYCLINES</b>	5.016	1.150	- 03.9
<b>AMPHENICOLS</b>	0.091	2.235	+ 02.1
<b>PENICILLINS</b>	19.902	1.896	- 18.0
<b>QUINOLONES</b>	-	0.011	+ 0.01
<b>MACROLIDES</b>	1.887	0.280	- 01.6
<b>CEPHALOSPORINS</b>	1.234	0.265	- 00.9
<b>AMINOGLYCOSIDES</b>	0.416	0.180	- 00.2
<b>OTHER ANTIBACTERIALS</b>	1.341	3.884	+ 02.5
<b>END TOTAL</b>	<b>41.715</b>	<b>9.899</b>	<b>- 31.816</b>

Table 3: Percentage (%) antibiotics consumption in the Eastern region of Libya during the periods (1991-1993) & (2012-2013).

<i>Drug group according to ATC classification</i>	<i>Average % drug consumed during 1991-1993</i>	<i>Average % drug consumed during 2012-2013</i>
<b>TETRACYCLINES</b>	12.16	23.06
<b>AMPHENICOLS</b>	00.23	14.45
<b>PENICILLINS</b>	50.34	26.71
<b>QUINOLONES</b>	-	00.16
<b>MACROLIDES</b>	04.49	02.97
<b>CEPHALOSPORINS</b>	03.05	03.44
<b>AMINOGLYCOSIDES</b>	01.01	02.46
<b>SULFONAMIDES</b>	13.64	-
<b>OTHER ANTIBACTERIALS</b>	14.94	26.68



**Table 4: Penicillins and fusidic acid consumption in Eastern region of Libya during the period 1991-1993 and 2012-2013**

<b>DRUG NAME</b>	<b>1991-1993 %FROM PENICILLINS</b>	<b>1991-1993 %FROM TOTAL ANTIBIOTICS</b>	<b>2012-2013 % FROM PENICILLINS</b>	<b>2012-2013 % FROM TOTAL ANTIBIOTICS</b>
AMOXICILLIN	01.35	0.52	26.37	5.15
AMPICILLIN	97.40	37.23	11.88	2.58
AMOXICILLIN + CLAVULANIC ACID	01.22	0.47	37.97	7.27
BENZATHINE PENICILLIN	-	0.73	02.64	0.56
PENICILLIN G	-	-	06.33	1.21
FLUCLOXACILLIN	-	0.39	10.6	2.03
CLOXACILLIN	-	5.21	01.85	0.35
OTHER ANTIBACTERIALS (FUSIDIC ACID)	-	0.20	-	38.25

**DISCUSSION:**

Surveillance of antimicrobial consumption is important in improving the quality of antimicrobial use. It is a key role in establishing the rationale for the use of antimicrobials. Countries with the highest per capita antibiotic consumption have the highest resistance [5]. This problem is a global one and DUS's have always been useful in emphasizing the problem and the pitfalls of daily prescribing of such group. Many organizations have recommended that antibacterial drug use at national levels should be monitored to better understand the relationship between the use of antibacterial drugs and emerging bacterial resistance [4&6].

All previous local studies from different areas of Eastern region of Libya from 1980 up to 2013 showed no changes in the prescribing and consumption pattern of antibiotics in spite of the obvious changes in number of populations in these areas during that period [7-19].

DDD cannot be used for the purpose of comparing costs of various treatment schemes, unless the DDDs are clinically equivalent in the actual cost [6&20]. But still ATC/DDD methodology is recommended by WHO experts to achieve comparative data for drug consumption between different countries.

Regarding the Eastern region of Libya, in general total consumption of antibiotics during the years 2012 & 2013 was far lower compared to that during the period 1991-1993 (Table 2). Decreased antibiotics consumption is a tricky figure as it may represent an improvement in antibiotics prescribing and consumption policy (a rational use) which consequently may reduce problems of allergy, resistance ... etc. but if such decreased antibiotic consumption do reflect diminished supply and availability which is below actual needs, then this would indicate that national drug policy needs a peer review, as antibiotics are life-saving drugs.

Current study showed decreased ampicillin consumption together with increased



augmentin consumption. This is in agreement with the fact that microbial resistance towards ampicillin was significantly shown previously in Libya [21]. This may also be supported by the observation that fusidic acid was used in large amounts after 17th February revolution compared to previous years.

The decreased consumption of penicillins together with increased consumption of amphenicols and fusidic acid complies with the pattern of antibiotic resistance reported previously in Libya [21].

Our study is subject to potential limitations. Firstly, current study is an ecological study – where data are collected on a population rather on an individual level. Therefore, the relationship between the observed levels of consumption and resistance should be interpreted with some caution. Secondly, data did not differentiate consumption in private and public sectors. Thirdly, in 2011, many drugs entered the Eastern region of Libya as donations and distribution process of these drugs were not clear, as a result, the total antimicrobial utilization in the Eastern region of Libya may be higher than that reported here.

The most effective approach for improving antimicrobial use is probably a combination of many interventions, which should be supported by government and regulatory authorities. Also, more restrictive policy and rational antibiotic guides are required.

## CONCLUSION

MSO since 2011 (post 17th February 2011 revolution) lost its control on importing medicines due to receiving many drugs as donations from different international sources without acceptable level of coordination. This has been reflected on drug purchasing policy of MSO during 2013, which failed to regain the previously accepted level of DDD/1000 inhabitants/day of antibiotics consumption. MSO must regain its control on importing medicines depending on clear policies that

should be built on professional accurate local studies, which comply with international reference standards.

## CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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ملخص باللغة العربية

استهلاك المضادات الحيوية في المنطقة الشرقية من ليبيا 2012-2013

عافية خليفة<sup>1</sup>، سالمة بوخطوة<sup>2\*</sup>، مصطفى الفاخري<sup>3</sup>  
1 قسم الممارسة الصيدلانية، كلية الصيدلة، الجامعة الليبية الدولية للعلوم الطبية، بنغازي، ليبيا  
2 قسم علم الادوية و السموم، كلية الصيدلة، جامعة بنغازي، بنغازي، ليبيا  
3 قسم الكيمياء الحيوية، كلية الطب، جامعة بنغازي، بنغازي، ليبيا  
\* المؤلف المسؤول: سالمة عبد الكريم بوخطوة. هاتف: 00218917240179، بريد إلكتروني: salma.bukhatwa@uob.edu.ly

**الخلفية:** أشارت دراسات استخدام العقاقير التي أجريت في ليبيا خلال الفترة 1991-2013 إلى الاستخدام غير الرشيد للمضادات الحيوية كممارسة شائعة تكلف النظام الصحي أكثر من 7.7 مليون دينار/سنة. الهدف من هذه الدراسة هو تقييم اتجاه استهلاك مضادات الميكروبات في المنطقة الشرقية من ليبيا خلال الفترة 2012-2013.

**الطرق:** تم الحصول على بيانات استهلاك مضادات الميكروبات من عامي 2012 و 2013 من ادارة الإمداد الطبية، مكتب بنغازي (الهيئة الرسمية الوحيدة المستوردة للادوية في ليبيا). وتتعلق هذه الدراسة بالمضادات الحيوية المستوردة فقط إلى المنطقة الشرقية من ليبيا، التي يمثل سكانها حوالي 35٪ من مجموع السكان الليبيين. واستخدمت في الدراسة، التصنيف التشريحي-العلاجي-الكيميائي، والجرعة اليومية المحددة لحساب استهلاك المضادات الحيوية وذلك طبقا لما توصى به منظمة الصحة العالمية. تم حساب إجمالي بيانات استهلاك مضادات الميكروبات على أساس الجرعة اليومية المحددة/ 1000 ساكن/ يوم.

**النتائج:** انخفض الاستخدام الكلي للمضادات الحيوية بشكل كبير من 15.47 جرعة يومية محددة/ 1000 ساكن/ يوم في عام 2012 إلى 4.30 جرعة يومية محددة/ 1000 ساكن/ يوم في عام 2013 وهذا بدوره يظهر انخفاضا كبيرا بالمقارنة مع 41.72 جرعة يومية محددة/ 1000 ساكن/ يوم خلال الفترة 1991-1993. انخفض استهلاك البنسلين من 19.902 دد/ 1000 ساكن/ يوم خلال 1991-1993 إلى 1.896 جرعة يومية محددة/ 1000 ساكن/ يوم خلال 2012-2013 مع نمط أموكسيسيلين / كلافيولانينك أسيد إستهلاك يساوي 3 أضعاف أمبيسيلين إستهلاك وهو الأعلى بالمقارنة مع جميع البنسلين. ورافق ذلك زيادة بارزة في استهلاك أمفينيكولات وحمض الفيوسيديك خلال الفترة 2012-2013، مشيرا إلى أن استهلاك حمض الفيوسيديك كان الأعلى بين جميع المضادات الحيوية في تلك الفترة.

**الاستنتاج:** منذ عام 2011 (بعد ثورة 17 فبراير / شباط 2011) فقدت ادارة الإمداد الطبي السيطرة على استيراد الأدوية بسبب تلقي العديد من الأدوية كתרعات من مصادر دولية مختلفة دون مستوى مقبول من التنسيق. وقد انعكس ذلك على سياسة شراء الأدوية التي وضعتها ادارة الإمداد الطبي خلال العام 2013، والتي فشلت في استعادة المستوى المقبول سابقا من استهلاك المضادات الحيوية في اليوم الواحد. انخفاض استهلاك البنسلين جنبا إلى جنب مع زيادة استهلاك أمفينيكولات وحمض فيوسيديك يتوافق مع نمط المقاومة للمضادات الحيوية ذكرت سابقا في ليبيا. وينبغي إجراء دراسات مماثلة لتقييم الاستهلاك الوطني للادوية في ظل الظروف العادية لمقارنتها مع البيانات الإقليمية والدولية.

**الكلمات المفتاحية:** ليبيا – الرعاية الصحية – الجرعة اليومية المحددة – حمض الفيوسيديك

