

# Analysis of Antimicrobial Medication Consumption in Intensive Care Unit, North West (Tabuk) Region Hospitals, Saudi Arabia

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Received: 12-01-2019;

Accepted: 29-02-2019

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[www.ptbreports.org](http://www.ptbreports.org)

DOI:  
10.5530/PTB.2019.5.22

## ABSTRACT

**Objectives:** This article describes antimicrobial medication use among different age groups and the cost associated with it in intensive care units at North West (Tabuk) hospitals, Saudi Arabia. The aim of this study to explore the antimicrobial medication use in intensive care units at North West Region Hospitals, Ministry of Health, Saudi Arabia. **Methods:** It is a 12-month antimicrobial drug use by intensive care units at North West region hospitals which included critical care for adults, pediatrics and neonates. The medications selected by Central Antibiotics committee at MOH as part of the National Antimicrobial Stewardship program. The consumption was driven from pharmacy database and calculated based on off standard unit of antimicrobials per hospital. The antimicrobials consisted of antibacterial drugs, antifungal and antiviral medications. The cost of antimicrobial consumption was calculated by using the Ministry of Health National Cost database. All cost used were as US currency. **Results:** The total number of antimicrobial standard units were (14,305) and average (2,861) per hospital. The highest drug consumption was Ceftriaxone 1 gm injection (2724) followed by Imipenem 500 mg injection (1251) and Vancomycin 500 injection (1165). The total cost of Antimicrobial consumption was (53,884.95 USD) and (10,777 USD) per each hospital. The highest cost medication consumption from Adults critical care 73.42% (39,562.33 USD) followed by pediatrics critical care 18.15% (9,779.93 USD) and Neonates critical care 8.43% (4,542.68 USD). The highest medication cost was very broad-spectrum antibiotics like Meropenem, Imipenem and Ceftriaxone. It consumed more than 50% of the cost burden. **Conclusion:** This study is the first in Saudi Arabia, Gulf and Middle East countries. Health system pharmacist leaders are targeting to implement the antimicrobial stewardship program and National Drug Utilization Evaluation system to control unnecessary medication expenditure and prevent misuse of medicines.

**Keyword:** Patient, Knowledge, Medications, Ministry of Health, Saudi Arabia.

## INTRODUCTION

There are several diseases that have been treated at the critical care department including, but not limited to cardiovascular or respiratory collapse, neurological disorders and infectious diseases. Most medications used in critical care services were antibiotics. The main infectious diseases induced mortality was due to septic shock. The international medical associations have released management guidelines for septic shock periodically.<sup>1</sup> The most diseases inducing mortality in the Kingdom of Saudi Arabia in the Hajj period were cardiovascular and infectious diseases.<sup>2</sup> The decision of using an antimicrobial is a challenge, as misuse or unnecessary use of antimicrobials are the major factors underlying the development of multi-drug resistance.<sup>3,4</sup> The local data showed antibiotic resistance in critical care units.<sup>5</sup> Antibiotics stewardship program started at the Ministry of Health hospitals about five years ago; however, it was not included in the critical care services.<sup>6,7</sup> To start the project, it is necessary to know the antibiotic consumption and economic burden on the health care system.<sup>8</sup> Several studies showed differences in types of antibiotics used in each country.<sup>9-13</sup> At best to the author's knowledge, there is no study done at KSA or Gulf and Middle East countries about antibiotics consumption in critical care services. The goal of the study is to explore the antibiotics consumption at critical care units in the Northern region (Tabuk) of the

Kingdom of Saudi Arabia.

## METHODS

This study shows a 9-month antimicrobial drug used through critical care units at North West region hospitals which includes all adults, pediatrics and neonatal population. Five hospitals were included included of which hospital 1 has been establish in 1980 to serve 100 beds and its, serves the maternities and pediatrics. Hospital 2 was hospital established in 1990, with the pharmacy care having many departments including, which they are inpatient, outpatient, narcotics, drug information center, clinics and emergency and serve 100 beds also has most specialties (pediatrics, OR, ICU, ER, nursery, AKU, and SW). Hospital 3 build was built up in 1983, which is containing 100 beds, all also all specialties are available except chemotherapeutic department. The pharmacy have several departments, which they are inpatient, outpatient, narcotics and emergency pharmacy. Hospital 4 was started in 1991, the capacity of the hospital is 200 bed, which is the largest in the region and also it does contain verities of specialized and served 7 departments. The pharmacy care units containing five departments which are inpatient, outpatient, narcotics, information center, emergency and clinics department. Hospital 5 hospital was established in 2005, which is the newest although the pharmacy serves 100 beds with different departments, they are including inpatient, outpatient, information

centers, narcotics, emergency and clinics, also cover 9 types of wards as the most hospitals in the region. Antibiotics committees were formulated at the above mentioned hospitals through a letter of recommendation which was sent by the General Administration of Pharmaceutical Care at the Ministry of Health for Tabuk Region on October 2013, which stipulates the importance of forming a specialized committee on antibiotics under the supervision and follow up of the department of pharmacy care in the region. Letters of formation of the Antibiotics Committee were sent to all hospitals in Tabuk region in January 2014. In March 2014, this committee was approved by the Director General of Health Affairs in Tabuk Region and guidance to start the application of antibiotics in all hospitals in the region. The actual implementation of the program began in January 2015. The objective of the antibiotic committees was to improve antimicrobial use for hospitalized adults and minimize the emergence and spread of antimicrobial resistance. The objective of the antibiotic committees was to improve antimicrobial use for hospitalized adult and minimizing the emergence and spread of antimicrobial resistance. While the functions of each committees were Supervising the assessment and application of antibiotic strategies in hospitals which are designed by the Antibiotics Committee of the Ministry. Preparation of quarterly reports on the implementation of strategies for the use of antibiotics in hospitals and discussed with the Committee of Pharmacy and therapeutics in the regions. Preparation of bacterial resistance statistics for antibiotics in the area and follow-up and updating. Supervising the training of medical staff (doctors, pharmacists, nurses, specialists, technicians) on the optimal use of antibiotics. Visits to hospitals to ensure the accuracy and validity of the implementation of strategies. Review and analyze indicators of the application of strategies for the use of antibiotics and consider their development in the region of Tabuk. And writing the annual report on the performance, productivity and impact of the program in the region of Tabuk. The antibiotics medications were selected by Central Antibiotics committee at MOH as part of the National Antimicrobial stewardship program. The consumption is driven from pharmacy database and calculated based on off stranded unit of antimicrobial per hospital. The antimicrobials consisted of antibacterial drugs, antifungal and antiviral medications. The cost of antimicrobial consumption was calculated by using Ministry of Health National Cost database. All cost used was as US currency.

## RESULTS

There were a total of five hospitals with 100-300 beds that represented 80% while hospitals with 50-99 beds that represented 20%. All hospital (100%) accredited by Saudi Board of Hospital Accreditation (CBAHI) while none (0%) of the hospital accredited by International Joint Commissions. The total response month's rate was 68 (50.37%) that included adults' response rate of 31 (68.88%), pediatrics response rate 18 (40%) and neonates response rate 19 (42.22%) (Table 1). The total number of antimicrobial standard units was (14,305) and average (2,861) per hospital. The highest units' consumption at adults' inpatient wards 10,712 (74.88%) followed by pediatrics wards 2,487 (17.39%) and neonates wards 1,514 (10.58%). The highest drug consumption as general was Ceftriaxone 1 gm injection (2724) followed by Imipenem 500 mg injection (1251) and Vancomycin 500 injection (1165). The highest drug consumption was Ceftriaxone 1 gm injection (1,918) followed by Imipenem + Cilastatin IV 500 mg (1,043) and Vancomycin IV 500 mg (794) at adults' critical care units. The highest drug consumption was Ceftriaxone 1 gm injection (592) followed by Vancomycin IV 500 mg (203) and Gentamicin IV 80 mg (160) at pediatrics' critical care units. The highest drug consumption was Ceftriaxone 1 gm injection (214) followed by Vancomycin IV 500 mg (168) and Levofloxacin IV 500 mg (140) at neonates' critical care units. The total cost of antimicrobial consumption was (53,884.95 USD) and (10,777 USD) per hospital. The highest cost medication con-

sumption from Adults critical care 73.42% (39,562.33 USD) followed by pediatrics critical care 18.15% (9,779.93 USD) and Neonates critical care 8.43% (4,542.68 USD). The highest drug cost consumption was Meropenem IV 500 mg injection (5,974.08 USD) followed by Ceftriaxone IV 1g (1,419.32 USD) and Vancomycin IV 500 mg (1,071.9 USD) at adult's critical care units. The highest drug cost consumption was Meropenem IV 1g injection (4,000.50 USD) followed by Meropenem IV 500 mg (1,904.00 USD) and Imipenem + Cilastatin IV 500 mg (1,650.00 USD) at pediatrics' critical care units. The highest drug cost consumption was Levofloxacin IV 500 mg (1,200 USD) followed by Meropenem IV 1 g (800.10 USD) and Meropenem IV 500 mg (680 USD) at neonates' critical care units. The highest medication cost was for very broad-spectrum antibiotics like Meropenem, Imipenem and Ceftriaxone. It consumed more than 50% of the cost burden (Table 2).

## DISCUSSION

The prime objective of this study was to determine the level of knowledge regarding antimicrobial medication consumption among study contestants in five major hospitals in Tabuk city. Antimicrobial stewardship programs in hospitals seek to enhance antimicrobial recommending in order to recover individual patient care as well as diminish hospital costs and slow the spread of antimicrobial resistance. These programs emphasis on confirming the proper use of antimicrobials to provide the best patient outcomes, decrease the risk of adverse effects, endorse cost-effectiveness and decrease or steady levels of resistance. The committee needs key performance indicators to measure the improvement and impact of the project. Several key performance indicators founded for instance the resistance pattern of the antibiotic bugs, adherence to antibiotics prescribing guidelines, adherence to monitoring parameters of some antibiotics need drug levels measurement and monitoring and antibiotics consumption. Critical care services presented most of the hospitals in the Northern region in Saudi Arabia. Intensive care is serving medical, surgical and trauma specialties. While there is intensive care in pediatrics and neonatal critical care services existed at several hospitals. The general administration of pharmaceutical care planned to implement antibiotics stewardship program for critical care services for all type of populations. The antibiotics consumption is essential information in demand to measure the clinical and economic impact of the project. This study showed that adult patients consumed a high percentage of antibiotics followed by pediatrics and neonates. The drug consumed most by adults, pediatrics and neonates was parenteral Ceftriaxone and Vancomycin that's similar previous study with utilization of third general cephalosporin.<sup>12</sup> The specific indication of usage for both antibiotics was not evident in the study and not included in the aim of the study. In neonates, the parenteral Quinolones were highly consumed; however, caused an adverse event to pediatrics less than eighteen years. The study showed that adult patients consumed two thirds of the antibiotics budget. This is expected because of usage of high quantity and expensive medications. The broader spectrum antibiotics Quinolones and a broad spectrum of  $\beta$ -lactam antibiotics were the highest consumed of all antibiotics in critical care services. The antibiotics stewardship program is essential at all intensive care services in the Northern critical care hospital services and is highly recommended in the Kingdom of Saudi Arabia.<sup>7,14,15</sup>

## CONCLUSION

The broad-spectrum antibiotics are highly used in the critical care services in the North West region, Saudi Arabia. Annual studies of antibiotics consumption and utilization are highly recommended. The antibiotic stewardship program is required in the kingdom of Saudi Arabia

**Table 1: Hospitals demographic data.**

	Hospital 1	Hospital 2	Hospital 3	Hospital 4	Hospital 5	Total
No of Beds						
<50						
50-99				YES		1(20%)
100-300	YES	YES	YES		YES	4 (80%)
301-400						
401-500						
CIBAHI	Yes	Yes	Yes	Yes	Yes	5 (100%)
JCI	No	No	No	No	No	0 (0%)
Repose Rate						
ICU units						
Adults	9	9	4	0	9	31 (68.88 %)
Pediatrics	0	6	4	0	8	18 (40 %)
Neonates	2	4	4	0	9	19 (42.22 %)
Total	11	19	12	0	26	68 (50.37 %)
Inpatient wards						
Adults	9	9	4	9	9	40 (88.88 %)
Pediatrics	7	9	4	9	9	38 (84.44 %)
Neonates	3	9	4	9	7	32 (71.11 %)
Total	19	27	12	27	25	110 (81.48 %)
OPD clinics						
Adults	9	9	4	0	8	30 (66.66 %)
Pediatrics	6	8	4	1	7	26 (57.77 %)
Neonates	0	8	4	0	0	12 (26.66 %)
Total	15	25	12	1	15	68 (50.37 %)
ER units						
Adults	9	5	4	0	0	18 (40 %)
Pediatrics	0	9	4	9	0	22 (48.88 %)
Neonates	0	5	4	0	0	9 (20 %)
Total	9	19	12	9	0	49 (36.29 %)

**Table 2: Anti-Microbial drugs consumption at critical care units.**

Quantity consumption Anti-infectious drugs	Dosage Forms	Neonates	Cost (USD)	Pediatrics	Cost (USD)	Adults	Cost (USD)	Total Quantities	Total cost (USD)
Cloxacillin sodium IV 250mg	Vial or amp.	0	0.00	20	7.78	6	2.334	26	10.11
Flucloxacillin sodium IV 250mg	Vial or amp.	20	7.78	0	0.00	30	11.67	50	19.45
Piperacillin + Tazobactam IV 2.25 g	Vial	62	84.32	70	95.20	409	556.24	541	735.76
Piperacillin + Tazobactam IV 4.5 g	Vial	20	43.73	120	262.40	480	1,049.61	620	1,355.75
Ceftazidime IV 1g	Vial	70	52.27	112	83.63	572	427.11	754	563.01
Ceftriaxone IV 1g	Vial	214	158.36	592	438.08	1918	1,419.32	2724	2,015.76
Cefepime IV 1g	Vial	10	18.76	10	18.76	129	242.004	149	279.52
Cefepime IV 2g	Vial	40	138.67	60	208.00	276	956.80	376	1,303.48
Imipenem + Cilastatin IV 500mg+500mg	Vial	58	638.00	150	1650.00	1043	11473	1251	13,761.00
Meropenem IV 500mg	Vial	50	680.00	140	1904.00	606	8241.6	796	10,825.60

**Table 2: Con'**

Meropenem IV 1g	Vial	30	800.10	150	4000.50	224	5,974.08	404	10,774.68
Tigecycline IV 50mg	Vial	0	0.00	0	0.00	10	500	10	500.00
Amikacin IV 100mg	Vial or amp.	76	24.62	65	21.06	200	64.8	341	110.48
Amikacin IV 500mg	Vial or amp.	70	31.50	100	45.00	561	252.45	731	328.95
Gentamicin IV 20mg	Vial or amp.	124	74.40	146	87.60	52	31.2	322	193.20
Gentamicin IV 80mg	Vial or amp.	70	42.00	160	96.00	469	281.4	699	419.40
Azithromycin PO 250mg	Tablet	0	0.00	40	2.88	616	44.352	656	47.23
Azithromycin PO 200mg/15ml	Suspension	82	77.89	119	113.04	0	0	201	190.93
Clindamycin IV 300mg	Ampoule	100	173.30	90	155.97	482	835.306	672	1,164.58
Vancomycin IV 500mg	Vial	168	226.80	203	274.05	794	1,071.9	1165	1,572.75
Linezolid PO 600mg	Tablet	0	0.00	0	0.00		0	0	0.00
Linezolid IV 600mg	Premixed bag	0	0.00	0	0.00	5	1750	5	1,750.00
Linezolid PO 100mg	Suspension	0	0.00	0	0.00		0	0	0.00
Rifabutine PO 150mg	Tablet	0	0.00	0	0.00	100	8.8	100	8.80
Ciprofloxacin IV 200mg	Bottle	30	22.17	20	14.78	339	250.521	389	287.47
Moxifloxacin IV 400mg	Vial	0	0.00	0	0.00	66	2211	66	2,211.00
Moxifloxacin PO 400mg	Tablet	0	0.00	40	45.20	154	174.02	194	219.22
Levofloxacin IV 500mg	Premixed bag	140	1,120.00	10	80.00	90	720	240	1,920.00
Amphotericin B liposomal 50mg	Vial	0	0.00	0	0.00	0	0	0	0.00
Amphotericin B 50mg	Vial	0	0.00	0	0.00	0	0	0	0.00
Voriconazole IV 200mg	Vial	0	0.00	0	0.00	0	0	0	0.00
Voriconazole PO 200mg	Tablet	0	0.00	0	0.00	0	0	0	0.00
Caspofungin IV 50mg	Vial	0	0.00	0	0.00	0	0	0	0.00
Micafungin IV 50 mg	Vial	0	0.00	0	0.00	0	0	0	0.00
Acyclovir IV 250mg	Vial	80	128.00	110	176.00	633	1,012.8	823	1,316.80
Valaciclovir PO 500mg	Tablet	0	0.00	0	0.00	0	0	0	0.00
Artemisinin PO 250mg	Capsule	0	0.00	0	0.00	0	0	0	0.00
Artesunate PO 50mg	Tablet	0	0.00	0	0.00	0	0	0	0.00
Artesunate IV 60mg	Ampoule	0	0.00	0	0.00	0	0	0	0.00
Proguanil PO 100mg	Tablet	0	0.00	0	0.00	0	0	0	0.00
Artemether +Lumefantrine PO 20/120mg	Tablet	0	0.00	0	0.00	0	0	0	0.00
Artemether IV 20mg	Ampoule	0	0.00	0	0.00	0	0	0	0.00

## ACKNOWLEDGEMENT

None.

## CONFLICT OF INTEREST

The authors declare no conflict of interest.

## ABBREVIATIONS

**ER:** Emergency; **KSA:** Kingdom of Saudi Arabia; **MOH:** Ministry of Health; **OR:** Operation; **ICU:** Intensive Care Unit; **AKU:** Artificial Kidney Unit; **SW:** Surgical Wards; **UDS:** Unite State Dollars.

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