

Prescribing pattern of antibiotics in AL-Elwia Pediatric Teaching Hospital, Baghdad, 2016.

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ABSTRACT

Background: Antibiotics are among the most commonly used medicine, in both community and hospital setting, all over the world especially in countries where no strict guideline to regulate their use. In Iraq, only a few studies conducted to describe the antibiotic prescription pattern in general hospitals and even less in pediatric hospital.

Objective: To describe the patterns for antibiotics used in Elwia pediatric teaching hospital in Baghdad, Iraq

Type of the study: Descriptive cross sectional study.

Methodology: The study was conducted at AL-Elwia Pediatric Teaching Hospital during the year 2016. A random sample from all the prescriptions sheets, of patients consulting outpatient clinic or admitted to different departments were studied for different parameters in different departments of the hospital.

Results: A total number of 9440 prescriptions, were collected and analyzed. The age group 1-5 years was the most common group consulting the hospital followed by those below 6 months of age. About 51% of all patients were

males. The study revealed that 87.56% of all patients consulting the hospital were received antibiotics. The highest rate of antibiotic used was in inpatient department (99.9%) followed by NNCU (92.11%). Amoxicillin was the most preferred antibiotics by pediatrician in outpatient, inpatient and ER department.

Conclusion: The results of this study indicate that there is, in general, overuse of antibiotics in all hospital departments when compared with other developing countries.

Keyword: antimicrobial, misuse, pediatric, Iraq

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Antibiotics are among the most commonly used medicine, in both community and hospital setting, all over the world especially in countries where no strict guideline to regulate their use. Each year, Antibiotics account for 24% of all new and repeated prescriptions (1). Irrational use of antibiotics includes not only the prescription of unnecessary antibiotics but also the use of broad spectrum antibiotics for infections where narrow spectrum agent is effective, multidrug prescription and unnecessary use of an expensive drug for simple infections. Infant and children are the most vulnerable group of population to contract illnesses leading to the risk of routine use of antibiotics in this age group. Infants during their first year of life are subjected to 3-6 episodes of infections. Most of these infections are of viral origin and it had been shown that only between 5% and 10% of fever episodes in young children are due to bacterial infections (2). Children younger than 15 years old constitute 28 % of the world total population (3) and in some countries, like India , might reach up to 40%(1). A Netherlands study covers the period from 1999 to 2005 found that antibiotics were the most common prescribed medications among children (4). Another study from Norway found the preschool children were the group most commonly exposed to antibiotics (5). Unfortunately, this overuse of antibiotics carries a risk of devastating health consequences on children (6, 7).

Despite being an essential medical resources, antibiotics when used irrationally carry a great risk for both individual and community. In addition to unnecessary exposure to medication and increase drug and hospital cost, misuse and abuse of antibiotics lead to emergent of drug resistant microorganisms, and multidrug resistant microorganism is a major health problem locally and worldwide (8). At hospital level, the risk of development of a dangerous nosocomial infections is well documented (9). All over the world, the prevalence of bacterial resistance had been progressively increased since the introduction of antibiotic and their massive use (10). The center for disease control estimate that among the 235 million dose of antibiotics prescribed each year in the United States, 20-50% were unnecessarily prescribed for viral infection (11). Implantation of guidelines to prescription antibiotics adopted by the ministry of health, together with a national campaign about the subject had led to declining trend in antibiotics prescription in many developed countries. In France, a national campaign led by ministry of health from 2001 till 2007 resulted in a decline in antibiotics consumption by 15-20% in primary care and by 10-15% in hospitals between 2003 and 2008(12). Knowledge and evaluation of the detailed prescription pattern of antibiotics in pediatrics hospitals are essential for construction and implementation of a proper guideline for antibiotic prescription in these

hospitals. Many of the provisional societies and international agencies like the centers for disease control and prevention in the USA (CDC) and WHO have framed a guideline to reduce the antibiotics use by the means of various control strategies aiming to guide physician to antibiotic when indicated only. The rational use of antibiotic were defined by CDC as "prescribing antibiotics only when they are likely to be beneficial to the patient, selecting agents that will target the likely pathogens and using these agents at the correct dose and for the proper duration" (13), and by WHO as "the cost-effective use of antimicrobials which maximizes clinical therapeutic effect while minimizing both drug-related toxicity and the development of antimicrobial resistance" (14). These guidelines can be adopted by ministry of health for implantation in our pediatric hospitals. For such guidelines to be adopted, a detailed knowledge of antibiotics prescription pattern is important. In Iraq, only a few studies conducted to describe the antibiotic prescription pattern in general hospitals (15-17) and even less in pediatric hospital (18). To the best of our knowledge, this study is the first to describe the antibiotics prescription pattern in pediatric hospital in Baghdad. So, the aim of this study was to describe the patterns for antibiotics used in Elwia pediatric teaching hospital in Baghdad, Iraq.

Methods: This descriptive cross sectional study was conducted at AL-Elwia Pediatric Teaching Hospital. It is a 200 bed referral hospital, in center of Baghdad. It has different departments including outpatient, inpatient, emergency (ER), and neonatal care unit (NNCU). Each working day, the hospital receive between 500-600 patients for medical consultation.

A random sample from all the prescriptions sheets, of patients consulting outpatient clinic or admitted to different departments during the year 2016, were reviewed. There were 137965 prescriptions during that year; a random sample of 10% of them was selected by simple random sampling. From 13797 prescriptions selected, 4359 were excluded because of incomplete data. 9440 (68.4%) prescriptions were completed and used for data analysis. Patient characteristics such as name, age, sex, & body weight were recorded. Data were also collected regarding the appropriateness of the dose of antibiotics per Kg body weight, the laboratory investigations (e.g. C - reactive protein, complete blood count, general urine examination, chest X ray) and reports of cultures for those admitted to the hospital. The data was collected quantitatively, counted numerically

and used to identify the prescribing pattern within the different hospital departments.

The antibiotics orders were reported including prescribed or not and if so the number of drug per prescription (monotherapy, ditherapy or polytherapy), type of antibiotic, route of administration and whether the dose is appropriate or not, along with the clinical diagnosis. The data were obtained and the patient related parameters were computed using Microsoft Excel 2013. The results were expressed as percentage proportion either as pictorial representation in the form of bar diagram, a pie chart or in the tabular form.

Results: A total number of 9440 prescriptions, were collected and analyzed. Table 1 shows demographic criteria of the study group. The age group 1-5 years was the most common group consulting the hospital followed by those below 6 months of age. About 51% of all patients were males. In our study, 87.56% of all patients consulting the hospital were received antibiotics. The highest rate of antibiotic used was in inpatient department (99.9%) followed by NNCU (92.11%) (Table 2). Table 3 shows the prescription pattern in the 4 departments of the hospital. More than half of patients receive single antibiotic (57.07%), about one third receive 2 antibiotics and only 0.63% receive triple antibiotics. The highest rate of double or triple antibiotics was in NNCU. The oral route was the most commonly used in outpatient department (99.87%) while intravenous route was the main route used in other departments (99.6%, 99.63%, 100% in inpatient, ER, NNCU respectively). The Intramuscular route was used only in 0.11% of all patients consulting the hospital. The calculated dose was appropriate in 67.98% of the patient. Blood and other specimen cultures were done in only 0.08%, other investigations in 8.02% and no investigations in 91.89%. Amoxicillin was the most preferred antibiotics by pediatrician in outpatient, inpatient and ER department. The most commonly used combinations were the metronidazole and methprim in outpatient department, amoxicillin and gentamicin in inpatient and NNCU department and metronidazole and gentamicin in ER department. The most common triple antibiotics combination used in ER department were amoxicillin, gentamicin and metronidazole while in NNCU the preferred triple antibiotics combination were ceftazidime, gentamicin and vancomycin (Figures 1-9). The respiratory diseases followed by gastroenteritis were the most common diagnosis for which antibiotics were prescribed in outpatient, inpatient and emergency department (Figure 10) while in NNCU, the RDS was the most common diagnosis (Figure 11).

Table 1: Demographic characteristics of studied groups.

Demographic criteria	Category	Department				
		All No (%)	Outpatient No (%)	In patient No (%)	Emergency No (%)	Neonatal care unit No (%)
Age	≤ 6 mos	2790(29.56)	928(13.3)	1030(51.39)	224(16.39)	608(100)
	6 mos-1year	1602(16.97)	1028(15.16)	316(15.75)	258(18.88)	
	1-5 yrs	3040(32.20)	1894(31.02)	538(26.84)	608(44.5)	
	≥ 5 yrs	2008(21.27)	1610(25.82)	122(6.08)	276(20.20)	
	Total	9440(100)	5460(57.84)	2006(21.25)	1366(14.47)	608(6.44)
Sex	Male	4874(51.63)	2500(45.78)	1202(59.92)	792(57.97)	380(62.5)
	Female	4566(48.37)	2960(54.22)	804(40.07)	574(42.02)	228(37.5)
	Total	9440(100)	5460(57.84)	2006(21.25)	1366(14.47)	608(6.44)

Table 2: Overall antibiotics prescribed in different Department.

Department	Total number of patients (%)	Number received antibiotic (%)
Outpatient	5460 (57.85)	4612 (84.46)
Inpatient	2006 (21.23)	2004(99.9)
Emergency	1366 (14.47)	1090(79.79)
NNCU	608(6.44)	560(92.11)
Total	9440(100)	8266(87.56)

Table 3: Antibiotic prescription in all department.

Variable	Category	Department				
		All No (%)	Out patient No (%)	In patient No (%)	Emergency No (%)	Neonatal care unit No (%)
Number of prescribed antibiotic	No antibiotic	1174(12.44)	848(15.53)	2(0.1)	276(20.20)	48(7.89)
	1 antibiotic	5387(57.07)	4070(74.54)	645(32.15)	670(49.04)	2(0.33)
	2 antibiotic	2820(29.87)	542(9.93)	1350(67.3)	392(28.69)	536(88.15)
	3 antibiotic	59(0.63)	0(0)	9(0.45)	28(2.05)	22(3.62)
	Total	9440(100)	5460(100)	2006(100)	1366(100)	608(100)
Route of administration	Oral	4615(55.83)	4606(99.87)	7(0.35)	2(0.18)	0
	Intramuscular	9(0.11)	6(0.13)	1(0.05)	2(0.18)	0
	intravenous	3642(44.06)	0	1996(99.6)	1086(99.63)	560(100)
Total	8266(100)	4612(100)	2004(100)	1090(100)	560(100)	
Dose	Appropriate	5619 (67.98)	2424(52.56)	1811(90.37)	901(82.66)	483(86.25)
	Not appropriate	2647(32.02)	2188(47.44)	193(9.63)	189(17.34)	77(13.75)
	Total	8266(100)	4612(100)	2004(100)	1090(100)	560(100)
Investigations	Blood and /or other specimen culture	7 (0.08)	0	3(0.15)	0	4(0.71)
	Other investigation	663 (8.02)	0	211(10.53)	302(27.71)	150(26.79)
	No investigation	7596 (91.89)	4612(100)	1790(89.32)	788(72.29)	406(72.5)
	Total	8266(100)	4612(100)	2004(100)	1090(100)	560(100)

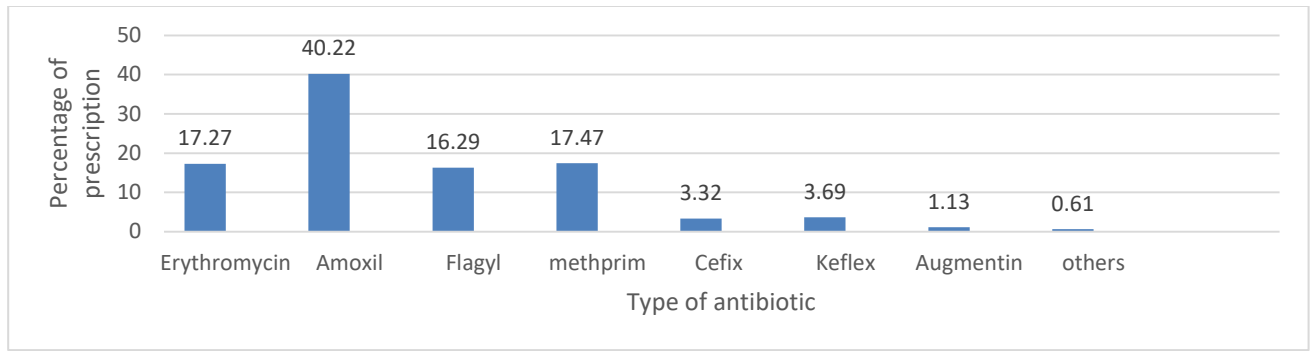


Figure 1: Single antibiotic used in outpatient department (Total 4070).

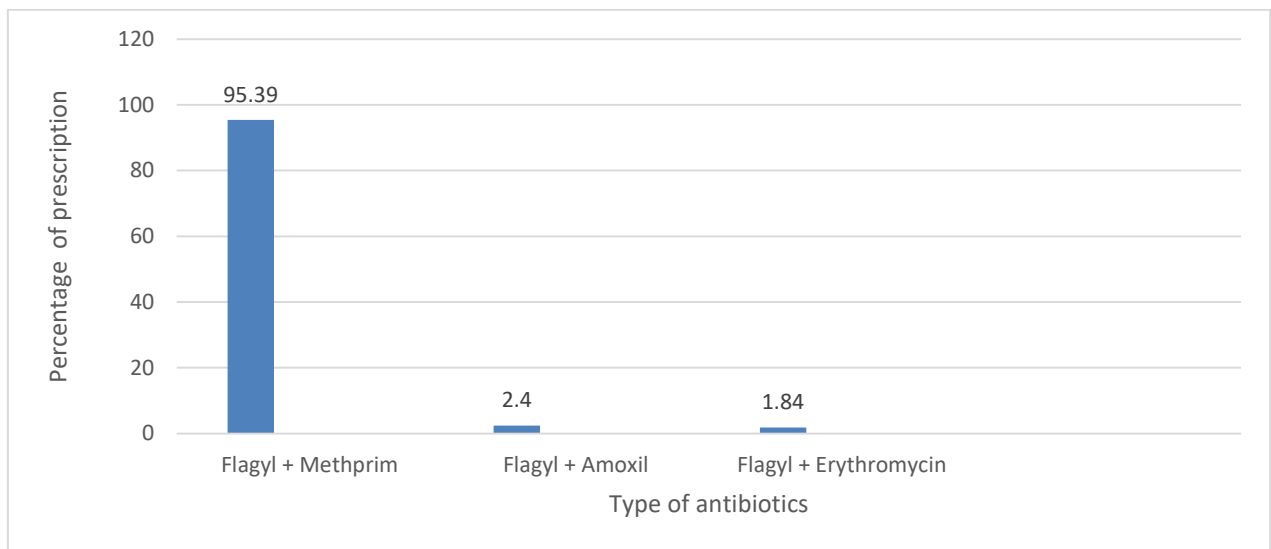


Figure 2: Double antibiotic used in outpatient department (Total 542).

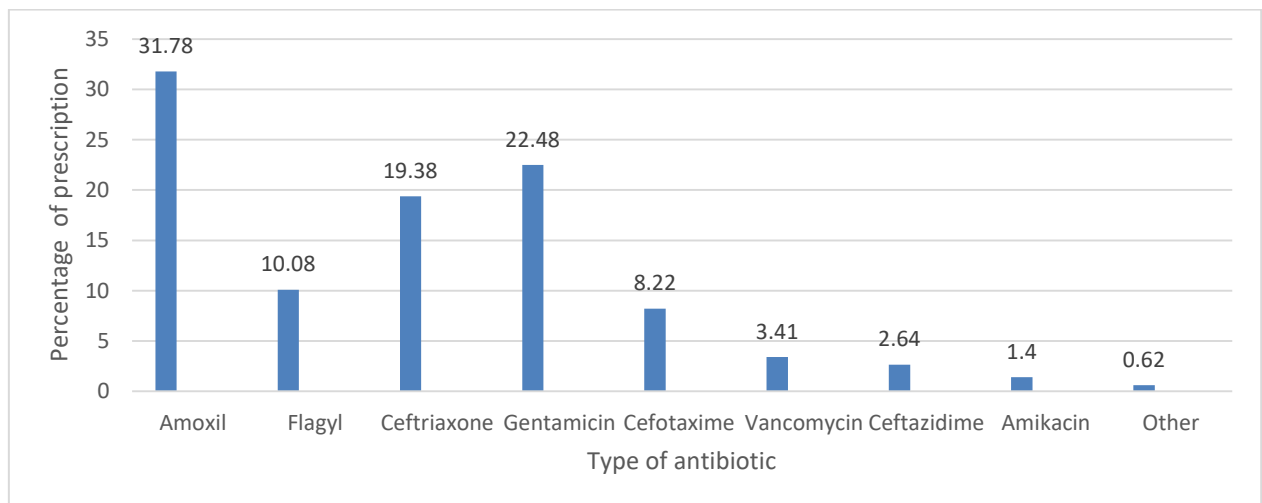


Figure 3: Single antibiotics prescribed in inpatient department (Total 645).

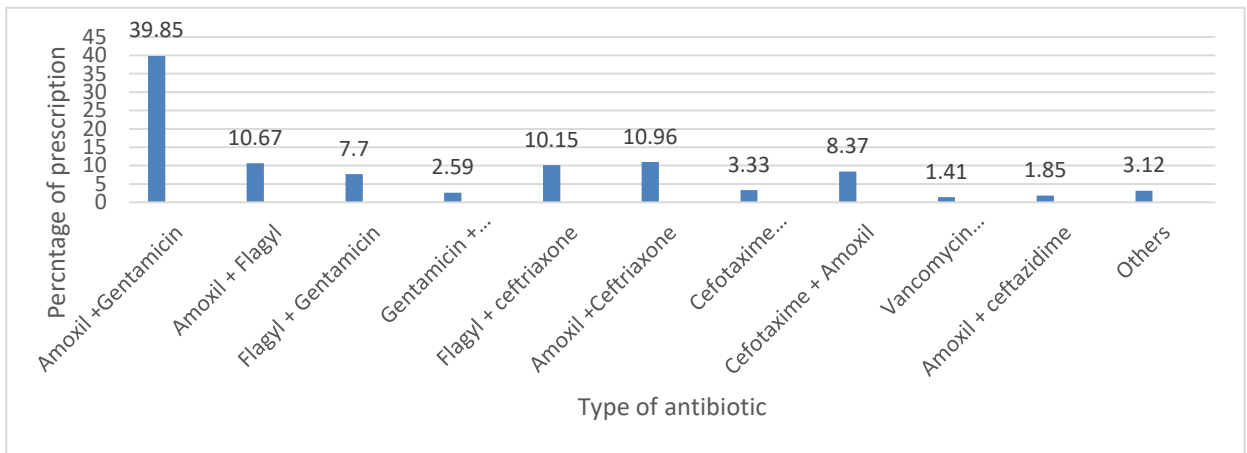


Figure 4: Double antibiotics prescribed in inpatient department (Total 1350).

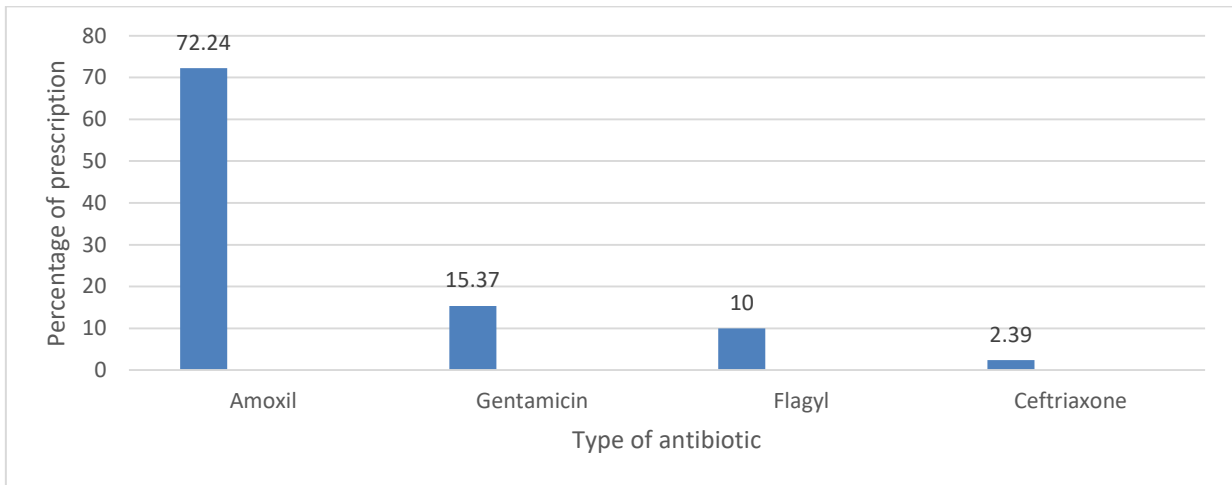


Figure 5: Single antibiotics prescribed in emergency department (Total 670).

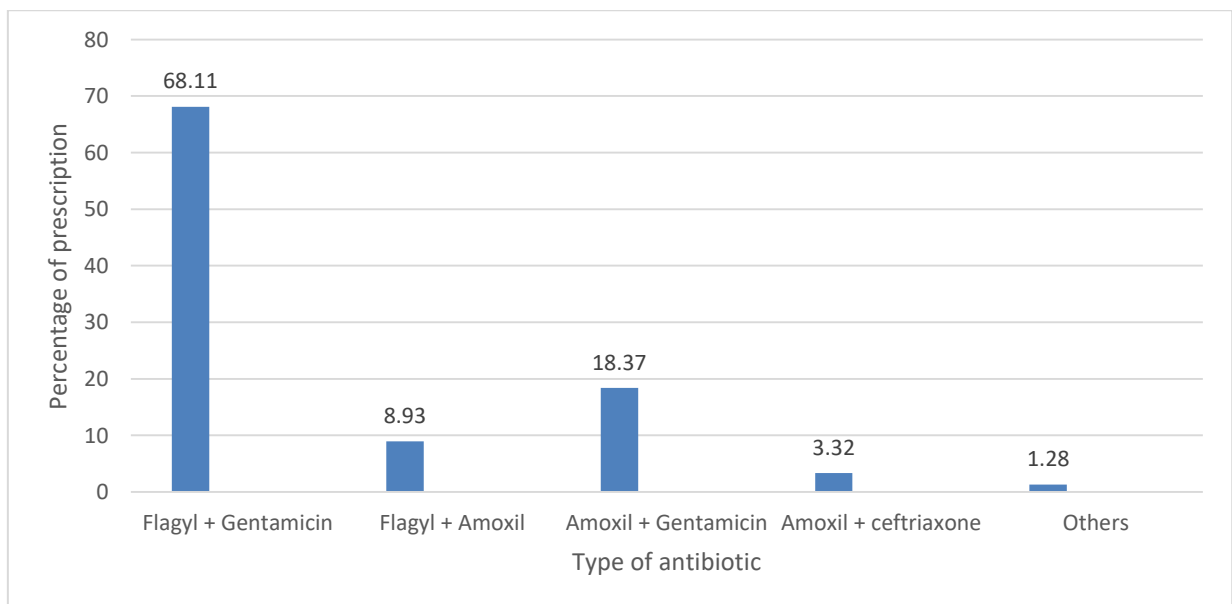


Figure 6: Double antibiotics prescribed in emergency department (Total 392).

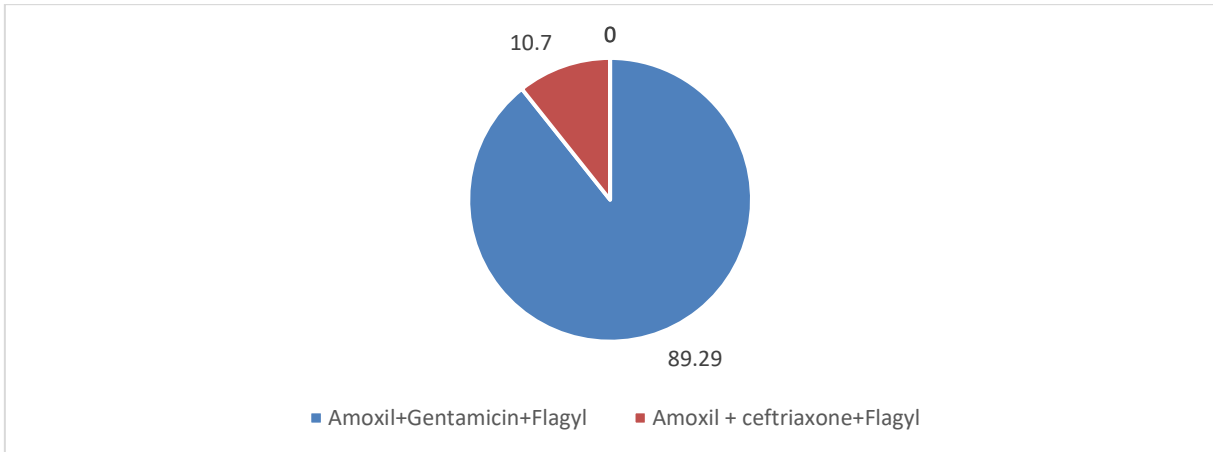


Figure 7: Triple antibiotics prescribed in emergency department (Total 28).

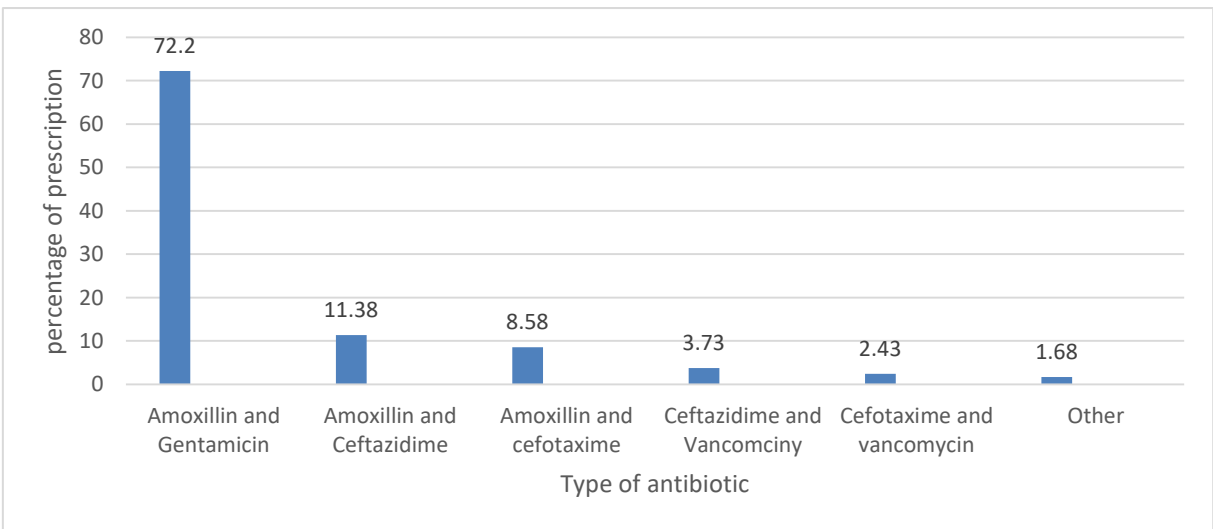


Figure 8: Double antibiotics prescribed in NNCU (Total 536).

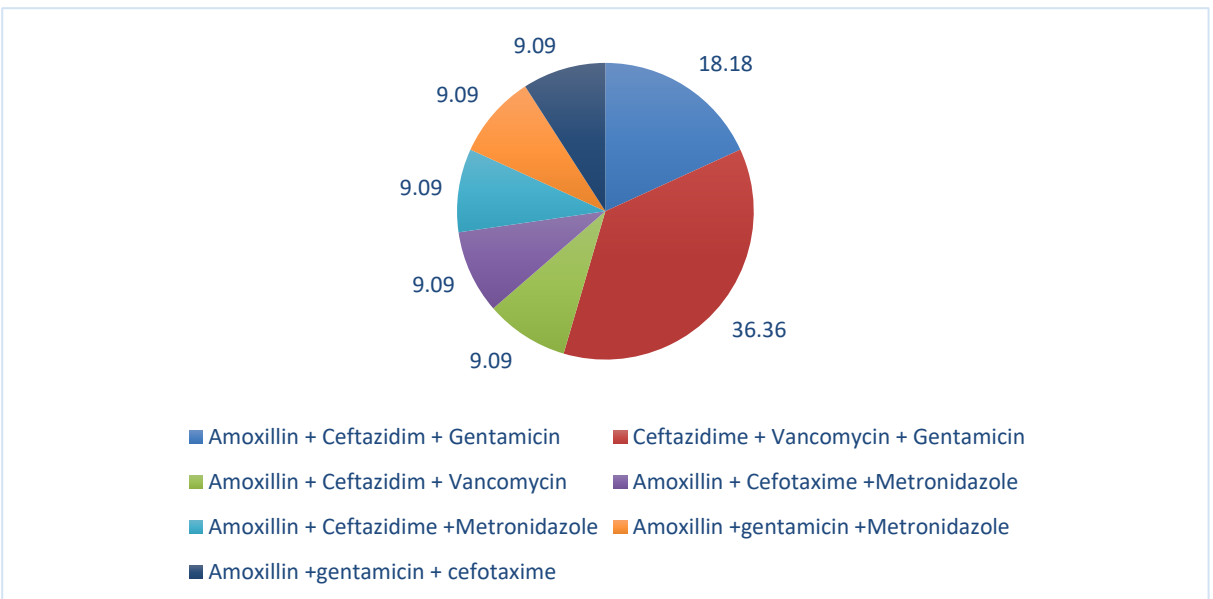


Figure 9: Triple antibiotics prescribed in NNCU (Total 22).

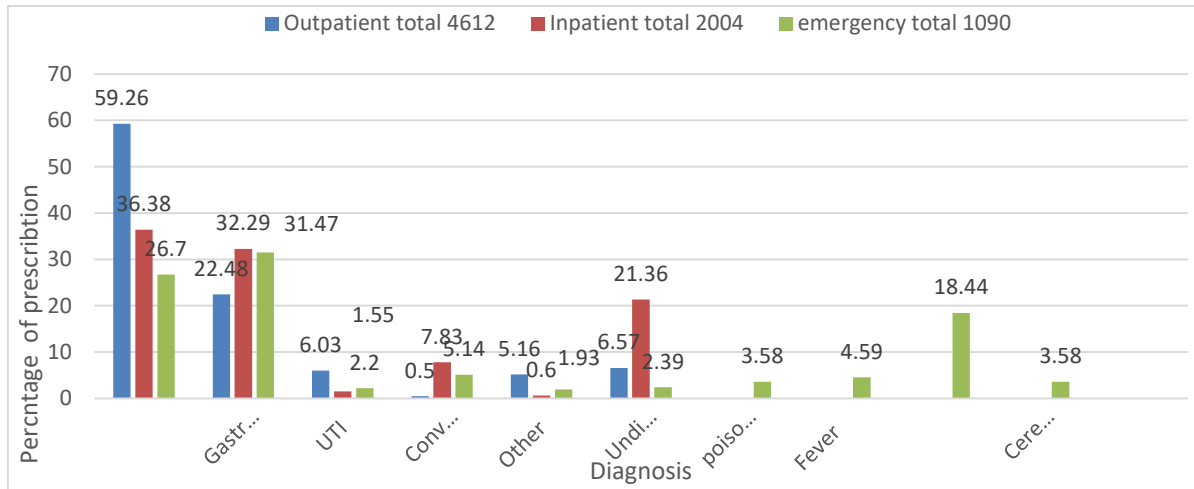


Figure 10: Indications for antibiotics in different department (Total 7706).

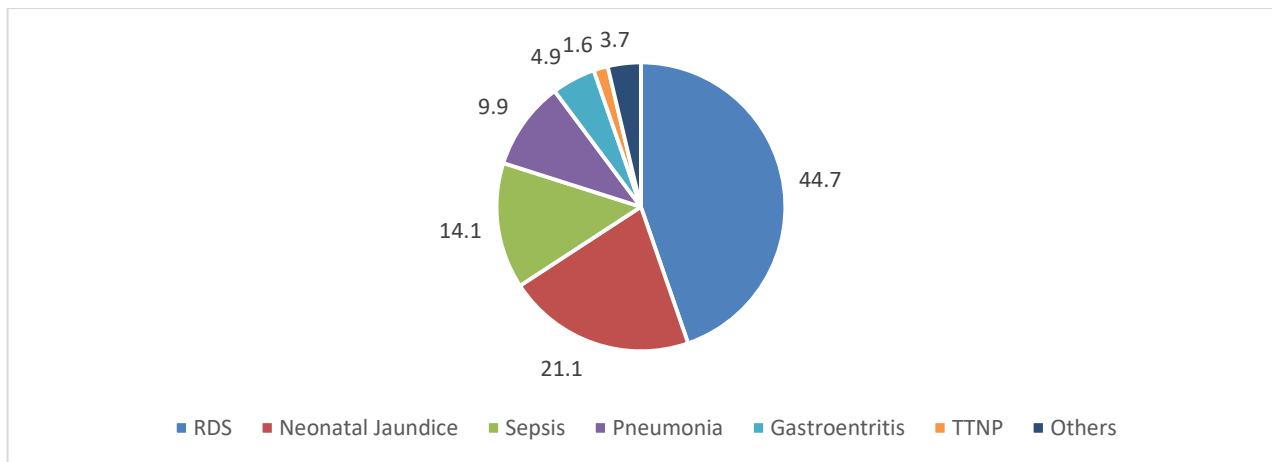


Figure 11: Indication for antibiotics in NNCU (Total 560).

Discussion: Antibiotics are the most commonly prescribed drugs in hospitals. Nearly 30% of all patients admitted to hospital in developed countries are treated with antibiotics (19). In United States, one-day prevalence surveys were conducted in acute care hospitals in 10 the states between May and September 2011 showed about half of hospitalized patients receive antibiotics. Half of them receive single antibiotic and the other half receive 2 or more (20). In developing countries, the problem of antibiotics misuse is clearer. Surveys on antibiotics use show it prescribed in 35 to 60% of clinical encounters although appropriate in less than 20% (21). Another study on inappropriate prescribing by physicians and other professional personnel in 12 developing countries also revealed an unnecessarily high proportion (25 to 75%) of patients receiving antibiotics during clinical visits (22). Antibiotic use is an important factor in induction and spread of antibiotic resistance. It is estimated that half of antibiotic prescriptions may be unnecessary (23).

The study sample showed balanced sex distribution with a predominantly aged less than one year (67.14%). This is expected as with advancing age the immune system becomes mature and the hygiene practice becomes better and hence, the rate of infectious disease is less. Our study showed that 87.56% of children consult the hospital during the study period had received antibiotics. In outpatient department, 84.46% of children received antibiotics. About 10% of them had received 2 antibiotics. A similar high result also observed from other developing countries. In a study from India, 84% of children visiting outpatient department receive single antibiotic and 16% receive more than one antibiotic (24). A similar high result of antibiotic prescription in outpatient department is also noted in Jordan 2013(25) but in study on pediatric outpatients' prescribing pattern in Saudi Arabia, the author found only 19.1% of the studied prescriptions were containing antibiotics (26). This difference in percentage of antibiotic prescription

is probably reflects the strictness in application of guidelines for antibiotics prescription in different countries. The highest rate of antibiotics prescription was noted in inpatient department. Nearly all patients receive antibiotics and about two third had received double antibiotics. A higher rate of antibiotics prescription is also noted in other developing countries. In a study from Ethiopia, antibiotics were prescribed for 79.8 % pediatric patients admitted to a university hospital (27). Other studies from India revealed a rate of prescription of 66 % (28) and from Oman a rate of 58% (29). The higher rate of antibiotics prescription in inpatient department, when compared to outpatients (99.9 % Vs. 84.46%) is expected since many of noninfectious cases consult outpatient department. This is despite the idea that antibiotic prescription in inpatient department tends to be more judicious pending the results of laboratory and radiological investigation. Regarding the ER department, our study shows a high rate of prescription (79.79%). In a study from Greece antibiotics were prescribed for only 15.8% of all seen and 40.6% of those diagnosed with acute infection in pediatric ER department (30). A lower rate also reported from Saudi Arabia of 18.5% (31). In the United States, each year in children hospitals, approximately 250 million antibiotic prescriptions are written from the ED; as many as 30% of antibiotics prescribed in the ED are considered either inappropriate or unnecessary (32). In our study, uncertainty of the diagnosis and inability to follow up assessment, alongside with the lack of strict implementation of proper guidelines for antibiotics treatment for the most common pediatric infections are probably the main reasons for high rate of antibiotics prescriptions in ER department.

The antibiotics are the most commonly used medicine in neonatal wards (33). A common practice of routine prescribing antibiotics, pending the results of culture and sensitivity, had led to a high rate of antibiotics exposure of 75-95 % in neonatal unit (34). The high rate of infection with its high rate of morbidity and mortality is probably behind this practice. Resistant to antibiotics is the major drawback of this practice. Our study shows 92% of patients admitted to NNCU had received antibiotics and the majority of them (88%) had received double antibiotics. This is a rather high rate when compared with finding of other studies. In two studies from India, a prescription rate of 70.7% and 56% were reported (35, 36). In a study from Kuwait involving one day survey in 4 hospitals, 48% of neonates had received antibiotics (37).

The oral route was the preferred one in the outpatient department. This is expected since the oral route is the cheapest and easiest for outpatient administration. Additionally, the hospital policy put a restriction on prescription of injectable antibiotics in outpatient. On the other hand, the intravenous route was the preferred route in the other departments. In a study from India,

pediatric department of a teaching hospital used intravenous route for antibiotic administration in 66% and the oral route used in 34%. The author concludes that the oral drugs are prescribed in the outpatient department more commonly as compared to the inpatient (38). Another study from Ethiopia showed similar results (39). In a study from Aden-Yemen, data revealed a 33% of antibiotics prescribed in outpatient department were injectable (40). Our study showed that the doses of antibiotics given in the hospital were inappropriate in 32%. The highest rate of inappropriate doses was in outpatients department. This is expected since the 500-600 patients consult the hospital each day is first filtered in the outpatient department with its resultant overcrowding. An important finding revealed by this study is that only 0.08% of all patients received antibiotics had any type of culture and sensitivity and in 91.89% there was no any investigation. Prescribing antibiotics according to culture and sensitivity is the gold standard for targeted therapy and it is routine for all neonate admitted to neonatal intensive care units (36). Prescribing antibiotic according to clinical diagnosis alone might not be adequate and it is better to be supported by hematological and microbiological studies. In a study from Yemen on antibiotics prescription in pediatric outpatient, 51% of the cases were sent for microbial testing (40). Regarding the type of antibiotic used, amoxicillin was the most predominant in all departments of the hospital, followed by erythromycin or methprim in outpatients, gentamicin or ceftriaxone in inpatients, and gentamicin in ER and NNCU. The most common combination used was metronidazole and methprim in outpatients, metronidazole and gentamicin in ER and amoxicillin and gentamicin in both inpatients and NNCU. The percentage of first line antibiotic is different from one country to other (29). This difference probably reflects many factors such as use of the policy of empirical therapy, prescribing attitude of pediatrician, economic factors, availability of ancillary aid for diagnosis and surely the availability of drugs. We didn't come across previous study in our hospital or other hospitals in Baghdad for comparison. Most patients consult outpatient department or admitted to inpatient department are complaining of respiratory infections followed by gastroenteritis (59.26%, 36.38% respectively). Similar results were obtained from Saudi Arabia (41, 42), Jordan (25), India (1, 38), Ethiopia (39), Palestine (43) and Yemen (40). This finding raises the possibility of irrational use of antibiotics since the majority of respiratory illness are of viral origin and it is in agreement with previous studies which shows pediatricians are more likely to prescribe antibiotics for respiratory tract infections especially if they face parents who expect prescriptions (41). Gastroenteritis followed by respiratory infections are the most common diagnosis in the ER department. This in contrast to Greece study where upper respiratory infection is the

most common. This difference is probably related to difference the disease epidemiology in different countries in addition to difference in the time period during which these studies were conducted. Respiratory syndrome and neonatal jaundice are the most common admitting diagnosis to

our NNCU.A study from India showed neonatal septicemia flowed by respiratory distress as the most common admission diagnosis (36).

In conclusion, we attempted to highlight the problem of antibiotics misuse in a pediatric teaching hospital in Baghdad. The results of this study indicate that there is, in general, overuse of antibiotics in all hospital departments when compared with other developing countries. Also, there is reluctant to use ancillary aids for proper diagnosis of infections and in turn the proper use of antibiotics. We recommend further prospective larger scope study involving multiple hospitals at national level, or at least frequent multicenter point prevalence survey, for better addressing the problem. Also, health authorities in the country should adopt projects and strategies to increase the awareness about antibiotics prescription among practicing physician through systemic approach and implementation of guidelines for antibiotics use in sick children.

References:

1. Choudhury D ,Deka A , Roy D. Pattern of Antibiotics Used in the Pediatrics Indoor Department at Silchar Medical College and Hospital, Assam, India. *Sch. J. Med. Sci.*, 2015;3(4C):1810-1814.
2. Craig JC, Williams GJ, Jones M, Codarini M, Macaskill P, Hayen A. et al. The accuracy of clinical symptoms and signs for the diagnosis of serious bacterial infection in young febrile children: prospective cohort study of 15 781 febrile illnesses. *BMJ* 2010; 340: c1594.
3. Viswanad V, Abraham S, Abraham A, Anupama PP, Muralidharan A, Arya SK. Confrontational Use Of Antibiotics In Pediatric Prescriptions. *Deccan J. Pharmaceutics and Cosmetology.* 2010;1(2):52-56.
4. de Jong J, van den Berg PB, de Vries TW, de Jong-van den Berg LT. Antibiotic drug use of children in the Netherlands from 1999 till 2005. *Eur J ClinPharmacol* 2008; 64:913–919.
5. Blix HS, Engeland A, Litleskare I, Ronning M. Age- and genderspecific antibacterial prescribing in Norway. *J AntimicrobChemother* 2007; 59:971–976.
6. Steinke DT, Bain DJ, MacDonald TM, Davey PG. Practice factors that influence antibiotic prescribing in general practice in Tayside. *J AntimicrobChemother.* 2000; 46:509-512.
7. Christakis DA, Zimmerman FJ, Wright JA, Garrison MM, Rivara FP, Davis RL. A randomized controlled trial of point-of-care evidence to improve the antibiotic prescribing practices for otitis media in children. *Pediatrics.* 2001; 107(2): 231-234.
8. World Health organization (2014) Antimicrobial Resistance. *ANTIMICROBIAL RESISTANCE Global Report on Surveillance.* Available: http://apps.who.int/iris/bitstream/10665/112642/1/9789241564748_eng.pdf. Accessed 22 March 2017.
9. Khan, H.A., Ahmad, A., Mehboob, R. Nosocomial infections and their control strategies, *Asian Pacific Journal of Tropical Biomedicine.* 2015; 5:509 - 514.
10. Wise RT, Hart, O. Cars, M. Streulens, R. Helmuth, P. Huovinen et al. Antimicrobial resistant: Is a major threat to public health (editorial). *Br.Med.J.*, 1998; 317:609-610.
11. Douglas Mackay ND. Can CAM Therapies Help Reduce Antibiotic Resistant. *Alternative Medicine Review* 2003; 8(1):28-42.
12. Marc C, Vrignaud B, Levieux K, Robine A, Gras-Le Guen C, Launay E. Inappropriate prescription of antibiotics in pediatric practice: Analysis of the prescriptions in primary care. *J Child Health Care* 2016. pii: 1367493516643421.
13. Bergman U, Wettermark B. Setting up and using the DU90% technique—a simple indicator for assessing the quality of drug prescribing. In *Handbook of Drug Use Research Methodology*, 1st Ed. McGavock H (ed). The United Kingdom Drug Utilization Research Group: Newcastle upon Tyne, 2000; 155-63.
14. World Health Organization DoCD, Containment SaRWGSf, Organization; oARGWH, http://www.who.int/csr/resources/publications/Af_drugresist/en/EGlobal_Strat.pdf. Accessed April 2017.
15. Jumaa KM, Hussein SA, Jaffer AM, Abdel Alaziz AS, Abdel Latif RA. Antibiotic Prescription Pattern in Surgery Department in Baquba Teaching Hospital. *The N Iraqi J Med* 2011; 7(2): 33-40.
16. Al-Nema ZM. Trend of Antibiotics Usage in the Intensive Care Unit in the Medical City in Baghdad. *Iraqi J Pharm Sci* 2016;25:50-58.
17. Al-Tukmagi HF, Wayyees ARM. Prescribing Pattern and Rational use of Drugs in Maysan Governorate, Iraq. *Iraqi J Pharm Sci, 2012; 21(1):112-116.*
18. Abdulghani ST. The Outcome of the Misuse of 3rd Generation Cephalosporins In Fallujah City, West of Iraq. *Anb Med J* 2012;10(2):46-50.
19. Van Der Meer, J.W.M. and Gyssens, I.C. (2001), Quality of antimicrobial drug prescription in hospital. *Clinical Microbiology and Infection*, 7: 12-15. doi:10.1046/j.1469-0691.7.s6.3.x
20. Magill SS, Edwards JR, Beldavs ZG, Dumyati G, Janelle SJ, Kainer MA, Lynfield R, Nadle J, Neuhauser MM, Ray SM, Richards K, Rodriguez R, Thompson DL, Fridkin SK, for the Emerging Infections Program Healthcare-Associated Infections and Antimicrobial Use Prevalence

- Survey Team. Prevalence of Antimicrobial Use in US Acute Care Hospitals, May-September 2011. *JAMA*. 2014;312(14):1438-1446. doi:10.1001/jama.2014.12923.
- 21 Trostle J. Inappropriate distribution of medicines by professionals in developing countries. *Social Science and Medicine* 1996;42(8):1117-1120.
 - 22 Hogerzeil HV et al. Field tests for rational drug use in twelve developing countries. *Lancet* 1993;342: 1408- 1410.
 - 23 Hicks, L. A., Taylor, T. H. & Hunkler, R. J. U.S. outpatient antibiotic prescribing, 2010. *N. Engl. J. Med.* 368, 1461-1462 (2013).
 - 24 Hitesh Mishra, Rajeev Mishra, ArkaMondal. Prescription pattern of antimicrobial drugs in pediatrics outpatient department of a tertiary care teaching hospital of North India. *Int J Basic ClinPharmacol*. 2014; 3(2): 385-388.
 - 25 Al-Niemat SI, Aljbouri TM, Goussous LS, Efaishat RA, Salah RK. Antibiotic Prescribing Patterns in Outpatient Emergency Clinics at Queen Rania Al Abdullah II Children's Hospital, Jordan, 2013. *Oman Med J* 2014 May; 29(4):250-254.
 - 26 Albarraq A A. Pediatric Outpatients' Prescribing Pattern, Saudi Arabia. *Journal of Society for development in new net environment in B&H*. 2015; 9(6): 213-219.
 - 27 Woldu MA, Suleman S, Workneh N, Berhane H. Retrospective Study of the Pattern of Antibiotic Use in Hawassa University Referral Hospital Pediatric Ward, Southern Ethiopia. *Journal of Applied Pharmaceutical Science* 2013.3;93-98.
 - 28 Choudhury DK ,Bezbaruah BK. Antibiotic Prescriptions Pattern in Paediatric In-Patient Department Gauhati Medical College and Hospital, Guwahati. *Journal of Applied Pharmaceutical Science* 2015;3:144-148.
 - 29 Al-Balushi K, Al-Ghafri F, Al-Sawafi F, Al-Zakwani I. Antibiotic prescribing trends in an Omani paediatric population. *Sultan Qaboos Univ Med J* 2014; 14:466-70.
 - 30 SoutanaKolyva, DespoinaGkentzi, ApostoliaKoulouri& Gabriel Dimitriou (2016): Antibiotic prescribing in the pediatric emergency department, *Journal of Chemotherapy*, DOI: 10.1080/1120009X.2015.1121008.
 - 31 Mohajer KA, Al-Yami SM,. Al-Jeraisy MI, Abolfotouh MA. Antibiotic prescribing in a pediatric emergency setting in central Saudi Arabia. *Saudi Med J* 2011; 32: 197-198.
 - Mistry RD ,Newland JG, Gerber JS, Hersh AL, May L, Perman SM, Kuppermann N, Dayan PS. Current State of Antimicrobial Stewardship in Children's Hospital Emergency Department. *Infect Control HospEpidemiol.* 2017;38(4):469-47
 32. Warriar I, Du W, Natarajan G. Patterns of drug utilization in a neonatal intensive care unit. *J ClinPharmacol* . 2006; 46:449-455.
 33. AnetaNO ,Anna M,Katarzyna Z ,Kazimierz W. Antibiotic consumption pattern in a single neonatal care unit. *Family Medicine & Primary Care Review* 2013; 15, 4: 552-555
 34. SonaliSuryawanshi1 ,Vijaya Pandit2 , Pradeep Suryawanshi3 , AditiPanditrao. Antibiotic Prescribing Pattern in a Tertiary Level Neonatal Intensive Care Unit. *Journal of Clinical and Diagnostic Research*. 2015 .9(11): FC21-FC24.
 35. Borade S, Ghodki S, Bhore A, Tiwari S, Jahagirdar S, Bansod K. Evaluation of antimicrobial prescription pattern in Neonatal Intensive care unit of tertiary care teaching hospital. *Int J Med Res Rev* 2014; 2(5):474- 479.
 36. Al-Sawan RMT, Sana AL, Al-Saleh Q, Al-Aify AA, Al-Essa M, Rajaramu U, Deverajan V. Misuse of antimicrobial agents on neonatal units: a cross-sectional survey in Kuwait. *Medicinal Principles and Practice* 1999; 8:119–25.
 37. Mohapatra S, Tripathy S, Balaji C, Rani RJ, Sekar P. Prescribing pattern of antimicrobial agents in pediatrics department of a teaching hospital. *Int J Basic ClinPharmacol* 2015; 4:753-6.
 38. Feleke M, Yenet W, Lenjisa JL. Prescribing pattern of antibiotics in pediatric wards of Bishoftu Hospital, East Ethiopia. *Int J Basic ClinPharmacol* 2013; 2:718-22.
 39. Alshakka M, Said K, Babakri M, Ansari M, Aldhubhani A, AzmiHassali M, Ibrahim MIM. A Study on Antibiotics Prescribing Pattern at Outpatient Department in four Hospitals in Aden-Yemen. *J Pharm Pract Community Med.* 2016; 2(3):88-93.
 40. Zolaly MA, Hanafi MI. Factors Affecting Antibiotics' Prescription in General Pediatric Clinics. *Journal of Taibah University Medical Sciences* 2011; 6(1): 33-41.
 41. Alakhali KM, Shaik Mohammed AA. Prescribing Pattern of Antibiotics in Pediatric Patients in the Jazan Region, Kingdom of Saudi Arabia. *RGUHS J Pharm Sci* 2014; 4 (3):120-124.
 42. Sawalha A, Al-Bishtawi G, Al-Khayyat L, Sweileh W, Al-Ramahi R, &Jaradat N. Pattern of Parenteral Antimicrobial Prescription among Pediatric Patients in Al-Watani Governmental Hospital in Palestine. *An - Najah Univ. J. Res. (Science)* 2006; 20:193-208.