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A Study of Rational Prescriptions of Penicillin and Cephalosporin Antibiotics in a Secodary Health Care Facility in South West Nigeria

By Omole, Moses Kayode Pharm. D & Adeola Adebisi Michael M. Pharm
University of Ibadan

Abstract - The purpose of this study is to assess the prescriptions pattern of penicillin and cephalosporin antibiotics among physicians at Sacred Heart Hospital Lantoro Abeokuta and determine their conformity with standard guidelines and principles of antibiotic use. It was a retrospective study involving data obtained from outpatient case notes that were prescribed with cephalosporin and penicillin antibiotics during the 6 months period of January to June 2010. A total of six hundred and fourteen (614) case notes were randomly selected and used for the study. One hundred and sixty seven (167) (**27%**) patients were of the age group 0 - 9 years, 31(**5%**) patients were aged 10 – 19 years and 226 (**37%**) patients were of age group 20 – 29 years . Four hundred and forty (440) (**71.7%**) patients were males while 174 (**28.3%**) patients were females. Among diagnosis studied were upper respiratory tract infection **(URTI)**238 (38.8%) and lower respiratory tract infection **(LRTI)**(**21.0%**) ($p = 0.00393$) ($p<0.05$). There was no definite diagnosis **(NDD)** made in 37 (**6.02%**) cases.

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Penicillins were prescribed for 474 (77.2%) patients and cephalosporins were prescribed for 140 (22.8%) patients. Both classes of antibiotics were prescribed most frequently for URTI. The cost of filling a prescription followed a normal curve distribution with the peak at the age group 35 – 49 years for both penicillins and cephalosporins antibiotics. Generic prescriptions were found to be 95(15.5%) for penicillins and 103(16.7%) cephalosporins. Prescriptions by proprietary names were 379(61.8%) for penicillins and 37(6.0%) for cephalosporins. Mean duration of prescription for penicillins was 6.65 ± 1.95 days while it was 5.5 ± 1.5 days for the cephalosporins. There was neither a case of microbial culture sensitivity test (MCS) nor a case of adverse effect documented.

The study showed that prescriptions pattern of penicillin and cephalosporin antibiotics were not completely in line with standard guidelines of antibiotic therapy. Measures should be taken to detect and document adverse drug reactions and consideration should be given to microbial culture sensitivity test.

Keywords : Antibiotics, Penicillins, Cephalosporins, Rational, Prescriptions.

Running Title : Rational prescriptions of Penicillins and Cephalosporins.

Author σ α : Department of Clinical Pharmacy and Pharmacy Adminis - -tration, Faculty of Pharmacy, University of Ibadan.
E-mail : kayodeomole06@yahoo.com

I. Introduction

Antibiotics are the most frequently prescribed and misused drugs and there are reported concerns about the continuous indiscriminate and excessive use of antibiotics leading to emergence of antibiotic-resistant organisms (N J Mclellan2001)(Krivoy et al 2007).

Despite the wide range of antibiotics available for treatment for infections, therapeutic failure has been increasingly experienced. This can largely be attributed to their irrational usage leading to development of resistant strains of bacteria. (N J Mclellan2001).

Rational use of antibiotics means that right antibiotics should be prescribed for the right patient in adequate dose for the sufficient duration as appropriate to the clinical needs of the patient at the lowest cost (WHO 1988). Many people are dying from infectious diseases that are curable but which no longer have the correct treatment.(Gaash B.2008). (Abdelsalam mohamed hamed Elfaki.2010)This is because certain bacteria are transforming themselves and developing increasing resistance to antibiotics. More than 80% of the most common bacteria, Staphylococcus aureus are now resistant to penicillin such as ampicillin (Henry F chembers.2004). The problem of irrational use of antibiotics is both complex and multi- faceted, but whatever its complexity, it should not be underestimated because it has a harmful influence on certain prevalent conditions such as caused by Staphyloccus aureus infections that can successfully be treated. Inappropriate drug prescriptions has been identified in many health facilities in Nigeria (Erah et al 2003) (Akande and Medubi 2009).,(Omole and Bello 2011).

The discovery of penicillin by Sir Alexander Fleming in 1928 ushered in the antibiotic era and transformed the practice of medicine (EH Decloedt et al 2008). It was however in 1940 that penicillin was produced in sufficient pure form to treat human infections. Many useful antibiotics have since been developed that belong to the penicillins. According to figures gathered during surveys by WHO in 2000, about 60% of antibiotics in Nigeria were prescribed unnecessarily. (Gaash B 2008).

The penicillins are classified as B-lactam drugs because of their four- membered lactam ring. They shared features of chemistry, mechanism of action, pharmacologic, clinical effect and immunologic characteristics with cephalosporins which are also B-lactam compound.

Studies had confirmed that these two classes of antibiotics (penicillins and cephalosporins) are widely prescribed. In a study (Palikhe N 2004) at pediatric hospital of Kathmada valley.,cephalosporins was the top most frequently prescribed antibiotics followed by penicillins. Penicillins were found to be more frequently prescribed than the cephalosporins in a study conducted at University of Ilorin teaching hospital (Akande et al 2009). Penicillins and cephalosporins were prescribed in more than half of the estimated emergency department visits for antibiotic-associated adverse events (E H Decloedt 2008). There is the need to prevent the age long antibiotics (Penicillins and Cephalosporins) from loss of efficacy by ensuring that they are rationally prescribed.

Not many studies have been conducted on rational prescriptions of these two classes of antibiotics by the Physicians in Nigeria. This study therefore examines the rational prescriptions of penicillin and cephalosporin antibiotics at Sacred Heart Hospital Abeokuta in Ogun State of Nigeria and determine their conformity with standard guidelines and principles of antibiotic use with the goal of providing and promoting pharmaceutical care.

II. Patients and Methods

Sacred Heart Hospital (SHH) is a secondary mission healthcare institution situated in Abeokuta, Ogun State in Nigeria. It was established in the year 1805 and currently attracts patients throughout the state and the neighboring states.

The study was a retrospective study involving data obtained from outpatients case notes. The data were collected from case notes of patients prescribed with either penicillin antibiotics or cephalosporin antibiotics or both antibiotics during the six months period of January to June 2010.

A total of 626 outpatient's case notes were randomly selected from the outpatients medical record. Twelve (12) patients' case notes were excluded from the study due to incomplete data. A total of 614 outpatient case notes were therefore used for the study.

Information obtained from the case notes were demographic data including age, sex, presenting complaint, laboratory investigations, penicillin and cephalosporin antibiotics prescribed in generic and proprietary names, dosage regimen, change in therapy, educational status of patients, marital status, microbial culture sensitivity (MCS) test, diagnosis made and adverse drug reactions.

The information obtained from each outpatient case note was entered using Epi info. Analysis was done using the Statistical Package for Social Sciences (SPSS) Version XII (12). Results were presented in frequencies, percentages, means and standard deviations. Two categorical variables were compared using the Chi-Square test and two unrelated variables were compared using Pearson correlation. Statistical significance was decided at the 5% level ($p<0.05$).

The management of Sacred Heart Hospital Lantoro Abeokuta granted the ethics to carry out this study.

III. Results

One hundred and sixty seven (167) (27%) patients were aged 0- 9years, 31 (5%) patients aged 10 – 19 years, 226 (37.0%) patients aged 20 – 29 years, 111 (18%) aged 30 – 39 years, 52 (8.5%) aged 40-49 years, 13 (2.2%) aged 50-59 years, 11 (1.8%) aged 60 - 69 years and 3 (0.5%) patients aged 70 years and above. Four hundred and forty (440) (71.7%) were males while 174 (28.3%) were females. (Table 1)

One hundred and eighty seven (187) (30.4%) patients aged 19 years and above had URTI. Patients aged 0 – 9 years had no UTI and PID. Two hundred and seventy nine (279) (45.3%) patients were diagnosed of URTI while pelvic inflammatory disease (PID) was diagnosed in 12 (2%) patients.(Table 2)

The penicillins and the cephalosporins were prescribed mostly for upper respiratory tract infection (URTI). Amoxycillin (penicillin) was prescribed for 61(9.9%) patients, Ampiclox (Ampicillin + Cloxacillin) for 99 (16.1%) patients and Amoxiclav for 30(4.8%) patients. The penicillins were not prescribed for pelvic inflammatory disease (PID) but Amoxiclav (Amoxicillin + Clavuric acid) was prescribed for 2 (0.3%) patients with PID. Cefuroxime the only cephalosporin was prescribed for all the conditions diagnosed. (Table 3)

The penicillins were prescribed for mean duration of 4.7 days for patients aged 0 - 5 years and 8.6 days for patients aged 18 – 34 years. The mean duration for cephalosporins prescribed ranged between 4.0 days for patients aged 0-5years and 7 days for patients aged 35-49 years.Both penicillins and cephalosporins were prescribed for the longest mean duration for patients in the age group 19 – 34 years and were prescribed for least mean duration for patients in the the age group 0 - 5 years. The average cost of filling each antibiotic prescription with the cephalosporins was found to be N1400.00 for patient in the age group 0 - 5 years. With the penicillins, the highest mean cost was found to be N655.00 for patients in the age group 35-49 years (Table 4). Table 4 further showed that the cost of filling each prescription followed a normal distribution with a peak at the age group 35 – 49 for both penicillins and cephalosporins.(Table 4)

Total prescriptions by proprietary names 416 (67.8%) were higher than generic prescriptions 198(32.2). Prescriptions by proprietary 379 (61.7%) were higher than the generic prescriptions 95 (15.4) for the penicillins whereas it was found to be lower 37(6%) than generic prescriptions 103 (16.7%) for the cephalosporins.(Table 5)

IV. Discussion

The number of male patients that were prescribed with penicillin and cephalosporin antibiotics was higher 440(71.7%) than female patients 174(28.3%). There was a significance association between drugs prescribed and sex (P= 0.00393) ($p<0.05$) (Table 1). This result was similar to the study conducted by Palikhe in 2004 in Kathmandu medical college, and study conducted at the university of Ilorin teaching hospital by Akande et al in 2009 which showed higher antibiotics prescriptions for males to be 54.0%. Patients in the age group 0 - 9 years were prescribed antibiotics 167 (27.0%) more frequently than older children aged 10 - 19 years 31(5.0%) There was a significance association between drugs prescribed and age. (P = 0.00393) ($p<0.05$). This was similar to the result obtained by Marlies et al in 1999 which showed that patients aged below ten years were treated with antibiotics more frequently 25% than those above ten years (11%) (P = 0.0256) ($p<0.05$) and the study conducted by Palikhe in 2004 which showed that patients below one year received antibiotic treatment more frequently than older patients.(Table 1).

Cephalosporins and penicillins were prescribed mostly for upper respiratory tract infections (URTI) 279(45.3%) and least prescribed for pelvic inflammatory disease (PID) 121(2.0 %). There was no definite diagnosis made in 45 patients (7.4%) (Table 2). This study showed that patients in the age group 0 – 9 years presented more frequently with upper respiratory tract infection 77 (12.5%) than for other infections. This may be due to the fact that infants have less developed respiratory organs and may be more prone to respiratory infections. There were no cases of pelvic inflammatory disease (PID) and urinary tract infection in this group of patients. PID and UTI were only presented by patients in the age group 18 years and above (Table 2)

Ampiclox® (Ampicillin + cloxacillin) 99(16.1%) was the most frequently prescribed penicillins. (Table 3) for URTI while Amoxiclav (Amoxycillin + clavulanic acid) 30(4.8%) was the least prescribed penicillins for the same condition. Cefuroxime in the form of suspension and tablet was the only cephalosporin prescribed in this study. Cefuroxime was prescribed mostly for URTI and least prescribed for PID. This was similar to the pattern seen with the penicillins. All the conditions were treated with single cephalosporin antibiotics (Table 3). This was similar to the study conducted by Palikhe in 2004 who reported that 93% of the patients studied were prescribed only with one antibiotics. He also reported that 75% cases of enteric fever was treated with single antibiotics. Other studies showed lower percentage treatment with single antibiotics 60.6% (Josefina and Caminnal et al 2005) and 36% (Marlies et al 199l). In the study conducted, penicillins were more frequently prescribed 474 (77.2%) than the cephalosporins 140 (22.8%). (Table 3). A study conducted at University of Ilorin Teaching Hospital (Akande et al 2009) reported higher prescription for penicillins (72%) than cephalosporins (28%.) Another study reported by Palikhe in 2004 indicated higher prescription for cephalosporins. The prescriptions of antibiotics in this study which was based mainly on clinical judgment (empirical treatment) without microbial culture sensitivity (MCS) test was similar to study conducted by Palikhe 2004. There was also a similar study conducted by Suping Hu et al 2002 which showed collection of specimen for culture to be only 8.4% among the patients prescribed with antibiotics. In all the cases considered in this study specimen for culture were not obtained. It is very necessary to ensure that specimen are obtained and cultured before initiating antibiotic therapy in some of the cases. Measures should be taken to avoid the inappropriate use of antibiotics to prevent antibiotics resistance, high health care costs and possible side effect including gastrointestinal side effect (Sneha et al 2006) (Saping 2009). Among the penicillins, the mean duration of prescription for penicillins was 6.3 days and 5.1 days for the cephalosporins (Table 4). This differed from mean duration of prescription 10.59 days reported by study conducted at University of Ilorin Teaching Hospital (Akande et al 2009).

Except for few conditions, the optimum duration of antibiotic treatment is unknown. Many antibiotics are often prescribed for duration of 5-7 days (Krivoy et al 2007) (Lim V Ket al 2009). Nevertheless it is reasonable to discontinue therapy even after a shorter period if patients' symptoms have resolved. There are however certain infections where prolonged treatment is necessary. In some conditions such as uncomplicated cystitis in women and gonococcal urethritis in males, single dose regimen have been shown to be effective for shorter duration.

Duration of therapy depends on the site and severity of infection such as tonsillitis – 10 days, bronchitis 5-7 days, urinary tract infection single shot to 21 days, lung abscess 2-8 weeks and tuberculosis 6-24 months. The frequency of administration was found to range from six- hourly of four times in twenty four hours to twelve-hourly of two times in twenty four hours with the penicillins and from twelve – hourly to once daily of one dose in twenty four hours with the cephalosporin. These are concurrent with the recommended standard

doses in literature (BNF 2009) (EMDEX 2006). Frequency of administration could be increased in cases of severe, deep seated and sequestrated infections and reduced in cases of renal failure. Only 198(32.2%) of the prescribed penicillins 95(15.5%) and cephalosporins 103(16.7%) were in generic names (Table 5). This is similar to 37.2% generic prescription reported by Abdel Salam in 2010. A similar study conducted at the teaching hospital Ilorin reported generic antibiotic prescription to be 45.6 %.(Akande et al 2009). There was a similar report in some African Countries where generic prescription of drugs is not a popular practice (Akande et al 2009).

Proprietary prescrition was relatively high (67.8%) (Table5). Generic prescription however, is the internationally accepted method of prescription. It follows therefore that the choice of either the cephalosporins or the penicillins was based on the discretion of the physicians. Oral route was used in all the cases considered for both penicillins and cephalosporins. This is expected as the patients were out patients and were able to tolerate oral medications.Exactly 6.1% of the antibiotics prescriptions were for common cold and catarrh. This is unnecessary as antibiotics are not appropriate for viral infections. In a Kentucky study, 60% of patients were prescribed antibiotics for common cold (Marlies A. Van 1999) (Sharm Rashimi et al 2005) (Sujit J Chandy 2008). There was no case of adverse drug reaction documented. This may be that there was no adverse drug reaction or that the case was not reported or documented. In a similar study by Palikhe in 2004,only 9% cases of adverse drug reaction were reported.

Antibiotic monotherapy was found to be high. Cases where combination therapy was used include Ampiclox (Ampicillin + cloxacillin). This combination displays synergy against some B-lactamase producing organisms since cloxacillin potentuates ampicillin antibacterial activity (Emdex 2006). Amoxiclav (Amoxycillin + clavulanic acid) was another combination therapy prescribed. Although clavulanic acid is not an antibiotic, it protects amoxicillin from enxymatic destruction by binding to them resulting in potentiation or synergistic effect.

There was no case of change in therapy probably because most of the cases might not have warranted antibiotics prescription in the first instance and due to the fact that culture sensitivity test was not done.

V. Conclusion

The use of antibiotics in the outpatient department (OPD) of Sacred Heart Hospital was not completely in line with the standard guidelines of antibiotic therapy as regards the generic prescriptions, cost and frequency of use. There is need in some cases to carry out a culture sensitivity test before prescribing antibiotics especially in children as their organs are not fully developed and they can easily suffer from toxic and adverse effects of drugs.

VI. Acknowlegdment

We hereby acknowledge the technical support and cooperation of the members of staff of Sacred Heart Hospital, Lantoro Abeokuta Ogun State, Nigeria.

Table 1 : Ages and sex distributon of patients prescribed with penicillins and cephalosporins. (N = 614).

AGE (YRS)	FREQUENCY			PERCENTAGE OF PEN AND CEP PRESCRIBED	
	PEN	CEP	TOTAL		
0 - 9	129	38	167	27.0	
10 - 19	24	7	31	5.0	
20 -29	174	52	226	37.0	
30 - 39	86	25	111	18.0	P = 0.00393
40 - 49	40	12	52	8.5	
50 - 59	10	3	13	2.2	
60 - 69	8	3	11	1.8	
70 & abv.	3	0	3	0.5	
Total			614	100.0	
SEX					
Male	249	91	440	71.7	
Female	130	44	174	28.3	
Total			**614**	**100.00**	

PEN = penicillin, CEP = cephalosporin.

Table 2 : Diagnoses based on different age group.

Diagnosis	Age (yrs)	Frequency		Percentage	
URTI	0 – 9	77		12.5	
	10 - 18	15		2.4	
	19 & above.	187	(279)	30.4	(45.3%)
LRTI	0 – 9	2		0.3	
	10 - 18	1		0.2	
	19 & abv.	20	(23)	3.3	(3.8%)
ENTERITIS	0 - 9	59		9.6	
	10 - 18	12		2.0	
	19 & abv.	62	(133)	10.0	(21.6%)
UTI	0 - 9	-		0.0	
	10 - 18	-		0.0	
	19 & abv.	73	(73)	11.9	(11.9%)
PID	0 - 9	-		0.00	
	10 - 18	-		0.00	
	19 & abv	12	(12)	2.0	(2.0%)
ENT. FEVER	0 - 9	7		1.1	
		1		0.2	
	19 & abv	41	(48.2)	6.7	(7.7%)
NDD	0 - 9	20		3.3	
	10- 18	4		0.7	
	19 & abv.	21	(45)	3.4	(7.4%)
TOTAL		**614**		**100.0**	**(100%)**

URTI : *Upper respiratory tract infection*
LRTI : *Lower respiratory tract infection*
ENTERITIS : *Enteritis*
UTI : *Urinary tract infection*
PID : *Pelvic inflammatory diseases*
ENT. FEVER : *Enteric fever*
NDD : *No definite diagnosis*

Table 3 : Penicillins and cephalosporins prescribed for different diagnosis N = 614.

Diagnosis	Amoxycillin (Penicillin)		Ampicillin+ cloxacillin		Amoxycillin+ clavulanic acid		Cefuroxime	
	Freq.	%	Freq.	%	Freq.	%	Freq,	%
URTI	61	9.9	99	16.1	30	4.8	48	7.8
LRTI	26	4.3	49	8.1	14	2.3	22	3.7
Enteritis	31	5.1	52	8.5	21	3.4	25	4.0
UTI	15	2.4	7	1.1	17	2.8	15	2.4
PID	0	0.0	0	0.0	2	0.3	5	0.8
Ent. Fev.	21	3.4	0	0.0	0	0.0	17	2.7
Others	10	1.6	16	2.6	3	0.5	8	1.4
Total	164	26.7	223	36.4	87	14.1	140	22.8

URTI : *Upper respiratory tract infection*
LRTI : *Lower respiratory tract infection*
ENTERITIS : *Enteritis*
UTI : *Urinary tract infection*
PID : *Pelvic inflammatory diseases*
ENT. FEVER : *Enteric fever*

Table 4 : Mean duration and cost of prescribed antibiotics.

AGE GRP.(yrs)	MEAN DURATION OF ANTIBIOTCS PRESCRIPED (DAYS)		MEAN COST OF ANTIBIOTICS PRESCRIBED Naira (Dollar)		MEAN COST OF ALL DRUGS PRESCRIBED
	PENICILLINS	CEPHALOSPORINS	PENICILLINS	CEPHALOSPORINS	
0 - 5	4.7	4.0	410(2.6)	1400(8.8)	1700(10.6)
6 - 10	5.1	6.0	430(2.7)	1125(7.0)	1345(8.4)
11 - 18	8.2	5.1	565(3.5)	950(5.9)	1100(6.9)
19 - 34	8.6	5.1	600(3.8)	950(5.9)	1105(6.9)
35 - 49	6.8	7	655(4.1)	1100(6.9)	1250(7.8)
50 - 69	5.2	4.3	450(2.8)	485(3.0)	523(3.3)
70 – abv	5.0	4.1	420(2.6)	475(3.0)	495(3.1)
MEAN %			20.40(0.1)	36.87(0.2)	42.73(0.3)

Convert to Naira to Dollar.

Table 5 : Prescriptions according to generic and proprietary.

PENICILLINS					CEPHALOSPORINS				
	GENERIC		PROPRIETARY			GENERIC		PROPRIETARY	
	freq	%	freq	%		freq	%	freq	%
Amoxycillin susp.	44	7.2	26	4.3	Cefuroxime susp.	41	6.7	13	2.1
Amoxycillin caps	51	8.3	43	7.0	Cefuroxime tab	62	10.0	24	3.9
Ampiclox susp			201	32.7					
Ampiclox caps	-	-	22	3.6					
Amoxiclav susp.		-	35	5.7					
Amoxiclav tablet	-	-	52	8.5					
Total %	95	15.5	379	61.8		103	16.7	37	6.0

Ampiclox = (ampicillin + cloxacillin), Amoxiclav = (amoxicillin + clavulanic acid).

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